SKYWAYS

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Navy
t-Fighters

page 14

AUG. 1951 25¢

esign Report on the Jet

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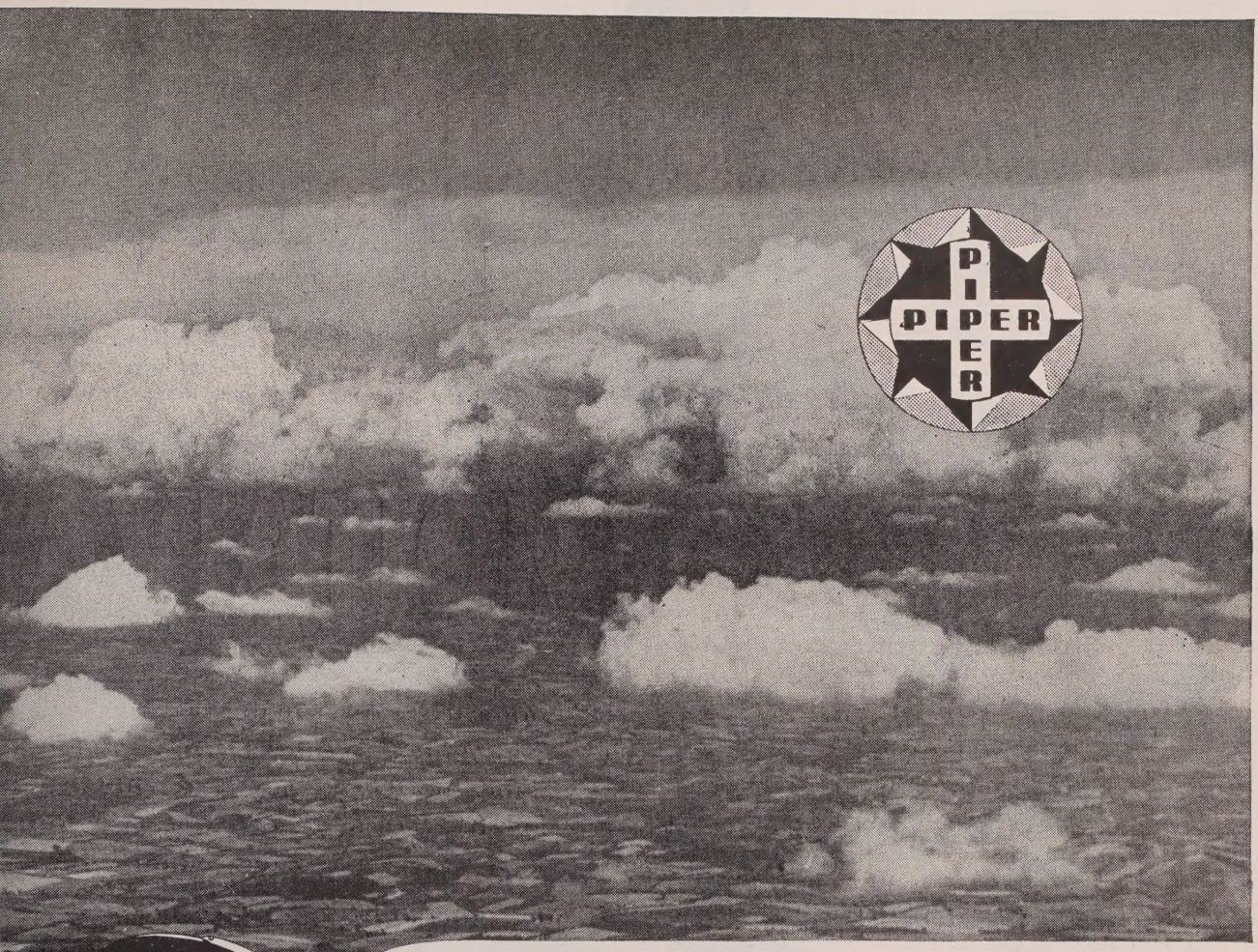

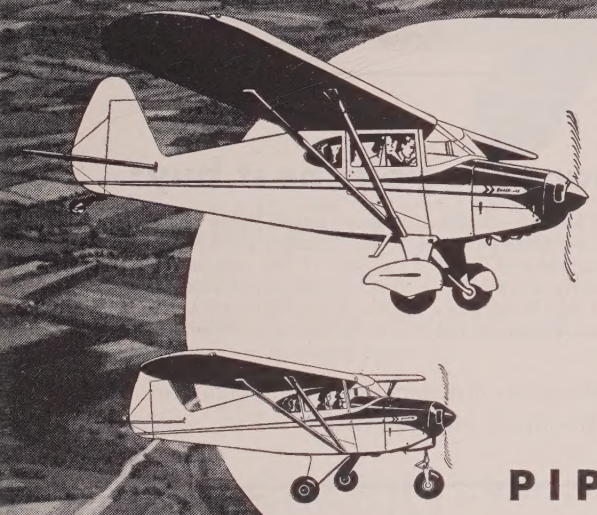

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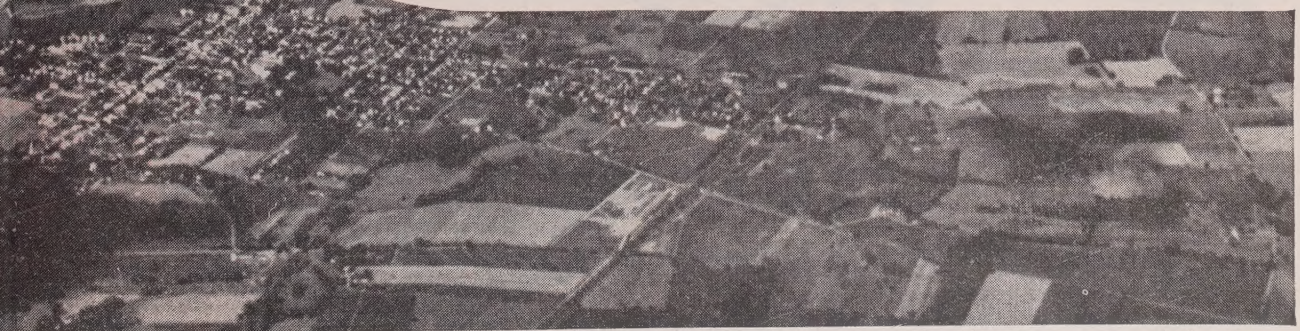
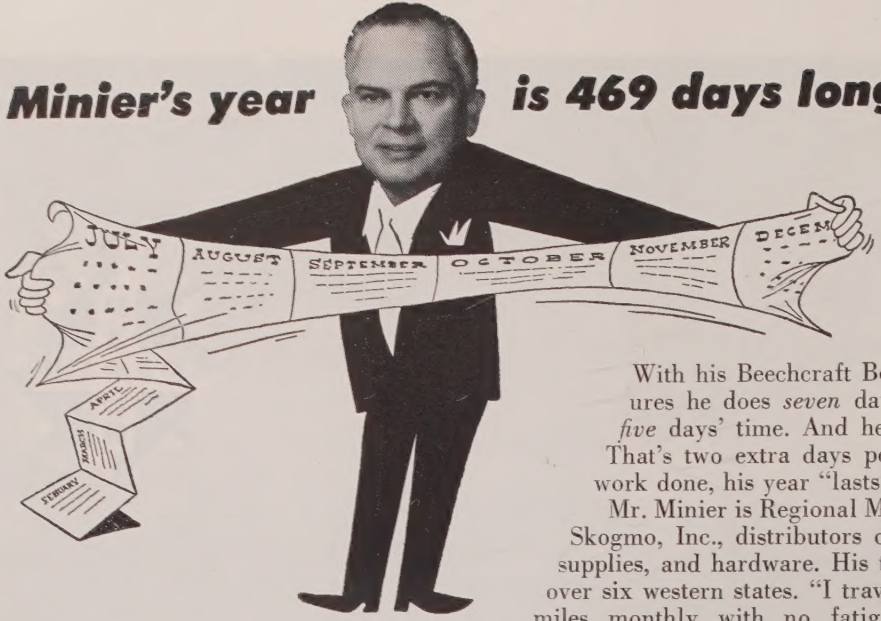


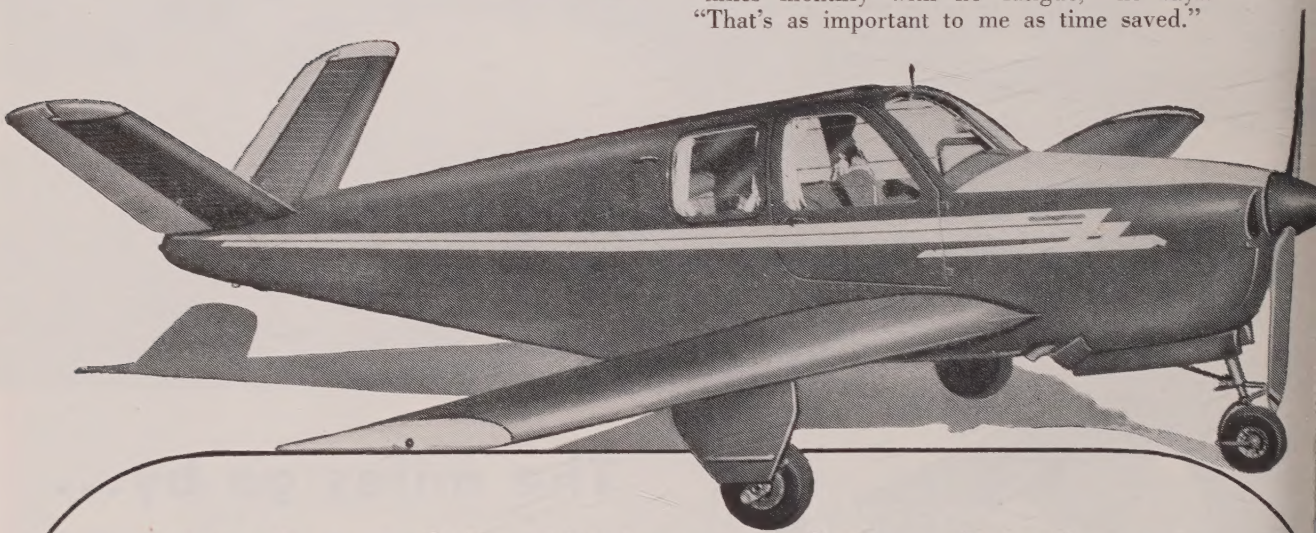
What kind of a navigator are you? *Valuable pair of Willson pilot glasses given to person identifying most accurately location of photo by Hans Groenhoff. Send entries before August 15, to Piper Aircraft Corporation, Lock Haven, Pennsylvania, Dept. K-8.*

Lon Minier's year is 469 days long!



With his Beechcraft Bonanza, Mr. Minier figures he does *seven* days' productive work in *five* days' time. And he has week ends free! That's two extra days per week. In terms of work done, his year "lasts" far longer.

Mr. Minier is Regional Manager of Gamble-Skogmo, Inc., distributors of auto and radio supplies, and hardware. His territory sprawls over six western states. "I travel thousands of miles monthly with no fatigue," he says. "That's as important to me as time saved."



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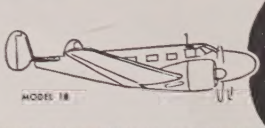

Beechcraft

BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

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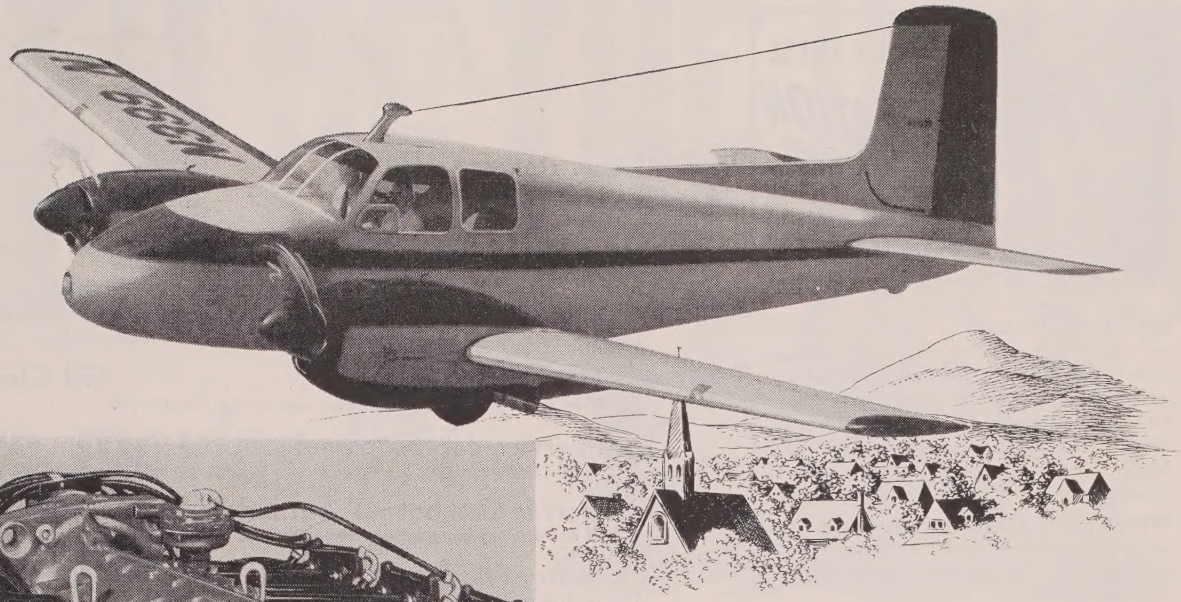

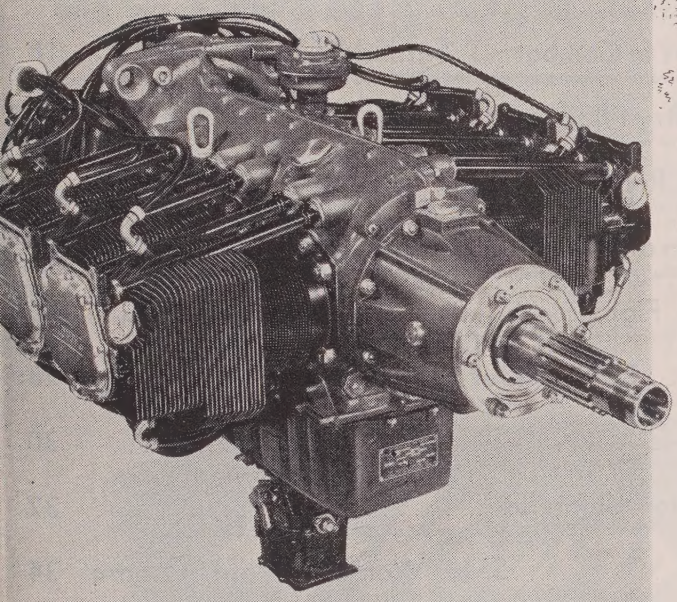

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SKYWAYS

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August, 1951

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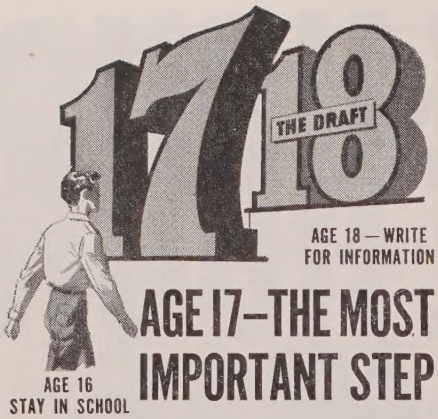

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AIR YOUR VIEWS

Wing-Tip Tanks

Gentlemen:

While reading your June issue, I came across an interesting story on pages 20 and 21. The pictures were good, too. But there is one thing I don't understand. On most F-94's the tanks are underslung beneath the wing tips, but on this particular F-94 the tip tanks are fitted on the ends of the wings. When did Lockheed start making F-94's like that?

JERRY PRICE

Monroe, N. C.

That particular F-94, Jerry, is the F-94B. The "A" version is the only model of the F-94 that employs the underslung tip tanks. The "B," "C," and, we believe, "D" versions are fitted with the tip tanks at the ends of the wing, not fitted under the tips.—ED.

"E" or "F"

Gentlemen:

Isn't that *Thunderjet* pictured on page 10 of the May issue an F-84F instead of an F-84E?

D. R. SMITH

Hillsdale, Mich.

No, sir, that's the "E" version. The F-84F has sweptback wings. See page 30 of the June issue. In the Air Force section, both the F-84E and F-84F are shown in three-view drawings. The F-84E pictured on page 10 does not have the tip tanks on it, but it carries them on some flights.
—ED.

Martin XB-51

Gentlemen:

In the picture of the Martin XB-51 in the Air Force section of the June issue, I noticed a hole or duct of some kind in the nose. What's it for?

D. SCOTT

Perryton, Texas

We couldn't answer you, Don Scott, so we contacted the Martin Company and asked one of the boys there. Here is his reply: "We have discussed this picture with our engineers and they have given us the following information—the object mentioned by Mr. Scott is neither a hole nor a duct. It is a blemish on the negative, and has no counterpart on the airplane itself." Hope that helps out in the arguments you have been having, Mr. Scott.—ED.

C-119

Gentlemen:

In your June issue you state the C-119 is still experimental, whereas in the March, 1948, issue you said it was in production. How come? I also would like to know what the B-30B, B-31, B-33 and B-41 manufacturers' names were.

A. MEDCALF

Buechel, Ky.

In 1948, the Air Force stated the C-119 was in production. In putting together that section of aircraft planes, your editor had the Air Force list the production, experimental, etc., aircraft so that the section would be accurate. Result: C-119 "in production but not operational." This year we did the same thing. Result: C-119 still experimental. Apparently changes were made in the airplane (one was elimination of that part of the rudder that extended below the twin booms) to such an extent that after that first production version it went back into the experimental category for further testing and evaluation. The XB-30 was a bomber designed by Lockheed, but no contract for production was ever issued. The XB-31 was a Douglas design, and again no contract for production was ever awarded. The B-33 was built by Glenn L. Martin Co., but a contract for that airplane was cancelled. The XB-41 was designed by Consolidated Vultee; had been previously designated XA-42 and only one was built.—ED.

Torque

Gentlemen:

Is there any torque when an engine drives contrarotating props? Also, how does an airspeed indicator work?

J. J. NORRIS

Philadelphia, Pa.

One of the advantages of dual-rotating props is that it neutralizes the engine torque reaction on airplanes with high wing loadings and large engines. The airspeed indicator is actually a pressure gage. It measures the dynamic pressure built up by the impact of air upon the airplane as the plane advances against the air. Since the impact pressure increases when the plane goes forward faster and decreases when it advances more slowly, it is possible to calibrate this pressure gage, called an airspeed indicator, in terms of airspeed in miles per hour.—ED.

Variable Incidence

Gentlemen:

In your Air Force section, you stated the Martin XB-51 had a "variable incidence wing." What is that?

ROBERT DORR

Silver Hill, Md.

A variable incidence wing is one in which the angle of incidence is varied by mechanical means. "Angle of incidence" is the angle of the wing setting.—ED.

F-80 vs. MIG-15

Gentlemen:

In a recent issue you stated in the article "Killer Jet in Korea" that the MIG-15 had no difficulty in showing its heels to the F-80. I disagree . . . and I happen to know the F-80 has shot down a number of MIG-15's.

G. A. LITAKER

Torrance, Calif.

Air Force men, including Gen. Hoyt S. Vandenberg, claim the MIG-15 is a shade slower on the straightaway than the F-86, but has a better rate of climb than the '86 and heavier firepower. It's pretty well known that the F-86 is faster than the F-80. The fact that the F-80 has shot down a number of MIG's doesn't necessarily mean the F-80 is faster. In combat, many a slower plane has defeated the faster one. The slower ship usually has a faster rate of turn. Here again we go back to that article in the January, 1943, copy of SKYWAYS "A Camel Outblows a Hurricane" (see Air Your Views, March, 1951). It's a fact, too, that the F-51 Mustang has knocked out a MIG or two . . . and the F-80 is faster than the '51. The F-80 is a good airplane, but it is fast becoming obsolete in jet warfare.—ED.

Civil Air Patrol

Gentlemen:

Your recommendation to Mr. A. M. Shelame Jr., was very complimentary to the Civil A Patrol. I am a member of the CAP, and durin my two years of membership I have gained n student pilot license. I was 17 in March and ha

out four hours of solo flight time. I appreciate ur recommendation, and hope that Mr. Shelaer Jr., does join the CAP Cadets.

LT. P. R. STILES

utchinson, Kan.

/hat is it?

entlemen:

In the May, 1951 issue on page 33, to the far ft of the bottom picture is a low-winged airane. What is it and do you have its performance gures?

EDW. MASTHAY

outhington, Conn.

That particular plane is an Ercoupe, a two-ace non-spin aircraft built by Engineering & esearch Corp., Riverdale, Md. It is powered y 85-hp Continental engine; has top speed 125 mph, cruises at 110 mph, and has a range 430 miles. The plane is available either as a o-control (non-spin) or conventional three-conol aircraft.—ED.

SAF, Tch-Tch

entlemen:

Being a former B-29 flight engineer, I would ke to offer you and the Air Force a correction. the AF ad in the March issue, the engineer as a handful of mixture controls: they are in e idle cut-off position, the engines are dead. ne only prop controls in a '29 are on the control edestal between the pilot and co-pilot.

R. C. LeBLEU

ntario, Calif.

Mr. LeBleu, you are so right. Note Air Your iews, page 6, July issue.—ED.

lane and Pix Info.

entlemen:

Where can I get some pictures of the cockpit the P-40E or P-40F? Is the Bell rocket ship signated X-1 or XS-1? Do you have any inforation concerning the XB-52 and the XP-81?

R. NOTTURNO

ynbrook, N. Y.

For photos and three-views of the P-40, try letter to Curtiss-Wright Corp., Wood-Ridge, J. The Bell research plane is designated X-1; S-1 is the old and not-used-anymore designation. e only info on the XB-52 that is available is at it is to be a heavy bomber, built by Boeing, d may be powered by eight jet engines. The P-81 was single-seater fighter powered by a E TG-100 propjet engine and 1-40 turbojet it. Only two were built (1945). It was said to ve had a speed in the vicinity of 500 mph.—ED

onocoupe and Trimmer

entlemen:

I would like the address of the manufacturers the *Monocoupe* as well as information on the immer amphib. Isn't it still being built? What ue had the special article, pilot's report, on the llanca *Cruisair?*

E. BRENDIN

n Diego, Calif.

Builder of the Monocoupe *is Monocoupe Airane & Engine Corp., Melbourne, Florida. The immer amphibian hasn't been in production for veral years. The parent company (Commonealth) went out of existence shortly after World ar II. SKYWAYS featured a pilot's report on e* Cruisair Sr., *back in 1947 . . . March, to be act.*—ED.

egent Rocket

ntlemen:

Do you have any information on the Regent cket 260? When it will fly? Engine? Design eed, etc.

R. JOHNSON

yrtle Beach, S. C.

The Regent Rocket *made its first flight April 1951. It is powered by 260-hp Lycoming ene; has a cruising speed of 177 mph on 75 r cent power, a top speed at sea level, normal ed power, of 198 mph, and a four-hour range. has a service ceiling of 16,000 feet and an itial rate of climb of 1,132 fpm. The Regent rcraft Corp. is located at Henderson, Texas.* —ED.

r Force Pilot-To-Be

ntlemen:

am very interested in becoming an Air Force ot. Could you suggest a way to help me pre-e for such a career?

RONALD JOHNSON

Hrore, Mass.

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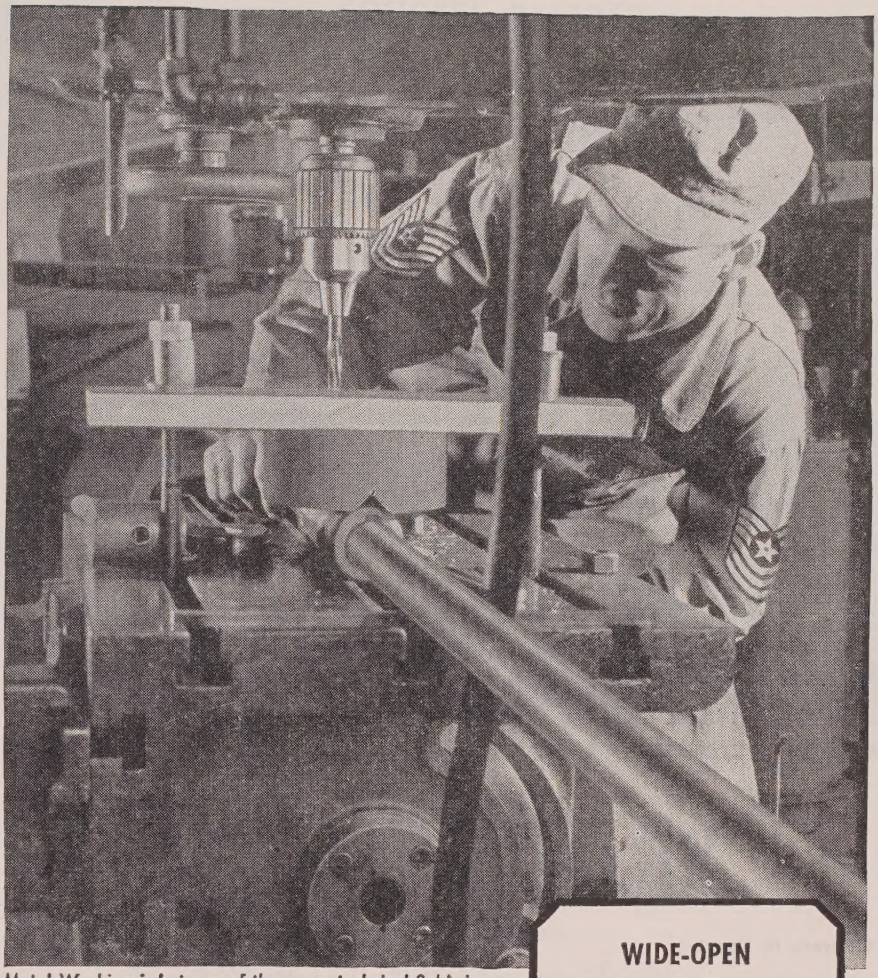

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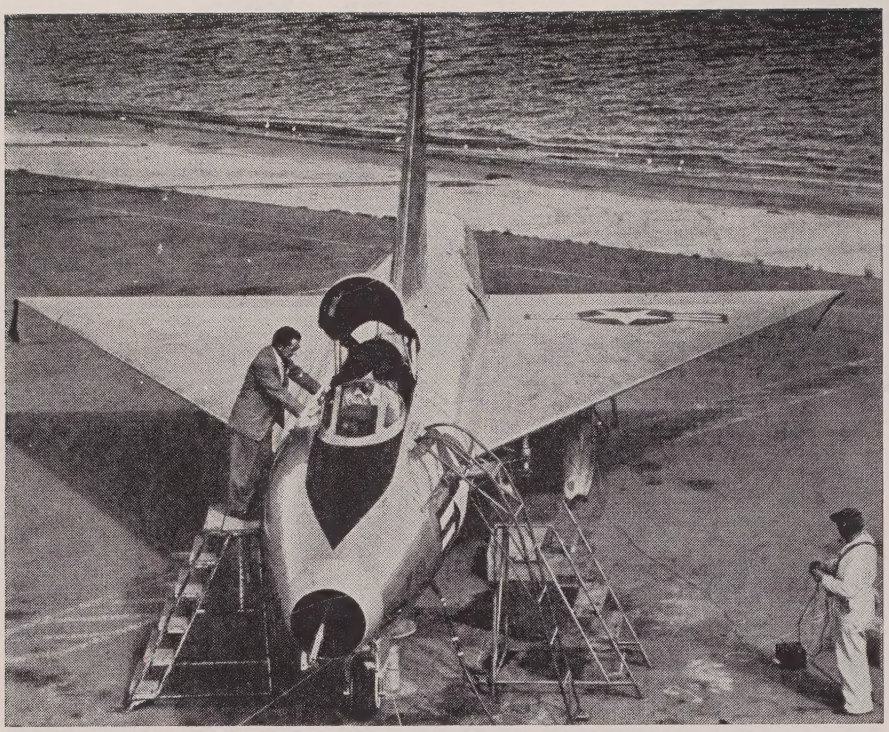

RESEARCH INTERCEPTOR XF-92A is powered by new Allison J33-A-29 with afterburner

MILITARY AVIATION

'Copters in Korea

Helicopters of all types are really doing a big job in Korea. At last report (end of April), the 'copters had safely evacuated more than 3,000 U.N. fighting men: over 1600 via Sikorskys that have been in operation since early in the conflict; 1,510 by Bell helicopters, first used in December.

USAF Interceptor

Now equipped with a more powerful engine (Allison J33-A-29 turbojet with afterburner), the Air Force's XF-92A research interceptor is resuming tests at Edwards AFB. The new engine develops considerably more thrust than the earlier Allison J22-A-23 which powered the XF-92A during its initial tests.

Phase II Tests Completed

The Fairchild XC-120 *Pack Plane*, first "trailer truck of the air," recently completed its Phase II flight tests at AMC's Wright-Patterson Air Force Base, Dayton, Ohio. In this phase of the test program, the XC-120 attained or exceeded everything it was designed to do. The plane now will be flown to the Air Proving Ground at Eglin AFB, Florida, for further evaluation.

British Vickers

Britain's first four-jet bomber, the Vickers 660, recently made its maiden flight and successfully passed its initial test. The bomber is powered by four Rolls-Royce *Avon* engines. It is reported to be faster than the Canberra and is said to have a far greater bomb load and range. Service ceiling of the "660" is given as 55,000 feet.

Lockheed List

Lockheed Aircraft Corporation now has quantity production orders for 12 different airplane models. Designs include all four basic types: fighters, bombers, trainers and transports. Five of the 12 are jet powered; the rest have conventional engines. Models thus far announced are:

F-94—Jet all-weather fighter
T-33—Air Force jet trainer
T0-2—Navy version of T-33
P2V-5—Long-range Navy bomber
749—*Constellation,* luxury transport
1049—*Super Constellation*
C-121C—AF version of Super Connie
R70-1—Navy version of Super Connie
P0-2W—Navy research/combat info plane

The other three models have not been announced by Lockheed.

Army Cubs

Piper has received an order for a number of observation reconnaissance planes for the U.S. Army. This is the third contract for liaison aircraft received by Piper since the start of the Korean war. The order calls for both L-18-C's and L-21's.

The L-21 is a high-performance two-place plane which can operate from short and unprepared fields. It is powered by 125-hp Lycoming engine, and is basically the same as the Piper *Super Cub*. The L-18-C is a 90-hp model of this same plane.

Supersonic Research

Bell Aircraft Corp., with six versions of the well-known X-1 in the process of building, is home base for what is considered to be the largest stable of high-altitude supersonic research aircraft in existence. Bell's planes are:

X-1—Designated "Number 3 X-1," it is to have turbine fuel pump which will add to plane's range and give it speed of 1700 mph at 80,000 feet.

X-1A, B, D—These are similar to the X-1, but have special instruments for special and specific aspects of supersonic flight.

X-2—This one is rocket powered like the X-1, but has sweptback wings, is built of stainless steel and is designed for higher speed and altitude than X-1.

X-5—The most secret of all Bell aircraft.

MATS Birthday

The Military Air Transport Service celebrated its third anniversary on June 1. Operating over 75,000 miles of aerial routes and flying more than 916,000,000 passenger miles and 243,000,000 ton miles in its third year of existence, MATS aircraft last year airlifted 400,000 passengers and 60,000 tons of critical cargo and mail in support of the Armed Forces. On return trips from Japan, MATS planes evacuated more than 26,000 battle casualties and other patients. Formed June 1, 1948, with the consolidation of two wartime air transport agencies—Air Transport Command (ATC) and the Naval Air Transport Service (NATS)—MATS became the first integrated organization under unification.

News Notes

TEMCO has been awarded a multi-million dollar contract for the manufacture of major components of the Douglas A2D *Skyshark*.

AIR MATERIEL COMMAND has awarded contracts for flight simulators to Curtiss-Wright, Link Aviation, North American and Engineering Research Corp.

ARMY has placed its third order for the Piper L-21 reconnaissance observation plane. Powered by 125-hp Lycoming engine, the L-21 can get off ground with full load in just 270 feet

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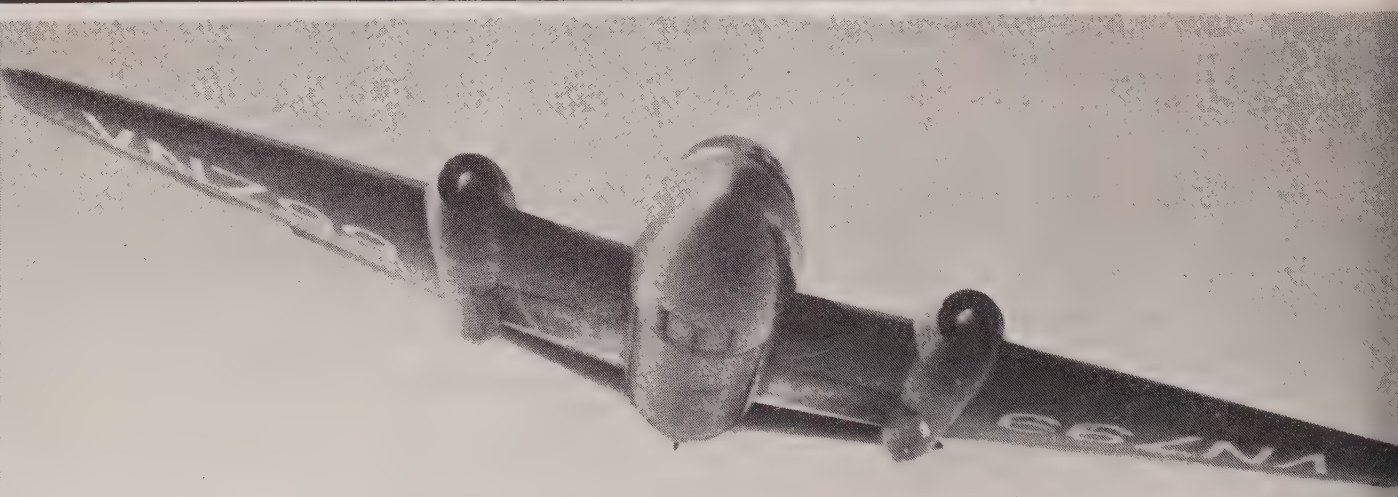
Design Report: Jet Canberra

CANBERRA began to take shape in 1944; first one flew in 1949; production versions now being delivered to RAF

POWERPLANTS of the *Canberra* are Rolls-Royce *Avons*. USAF version (B-57A) may be powered by Wright J-65's



English twin-jet bomber, Canberra, wins pilot plaudits; to be built for AF by Martin Co.

By WILLIAM GREEN

IT WAS around lunchtime at RAF Station Aldergrove on February 21 when an RAF sergeant took a stick of chalk and wrote on the departure board, "*Canberra* airborne 12:43. ETA Gander 1656 hrs." This simple inscription meant that Britain's first jet bomber, the English Electric *Canberra*, was on its way across the Atlantic, shortly to receive the plaudits of the USAF; praise destined to result in a production order for this remarkable and versatile airplane with Glenn L. Martin's Baltimore plant where, as the B-57A, it will roll off the assembly lines as an Air Force night intruder.

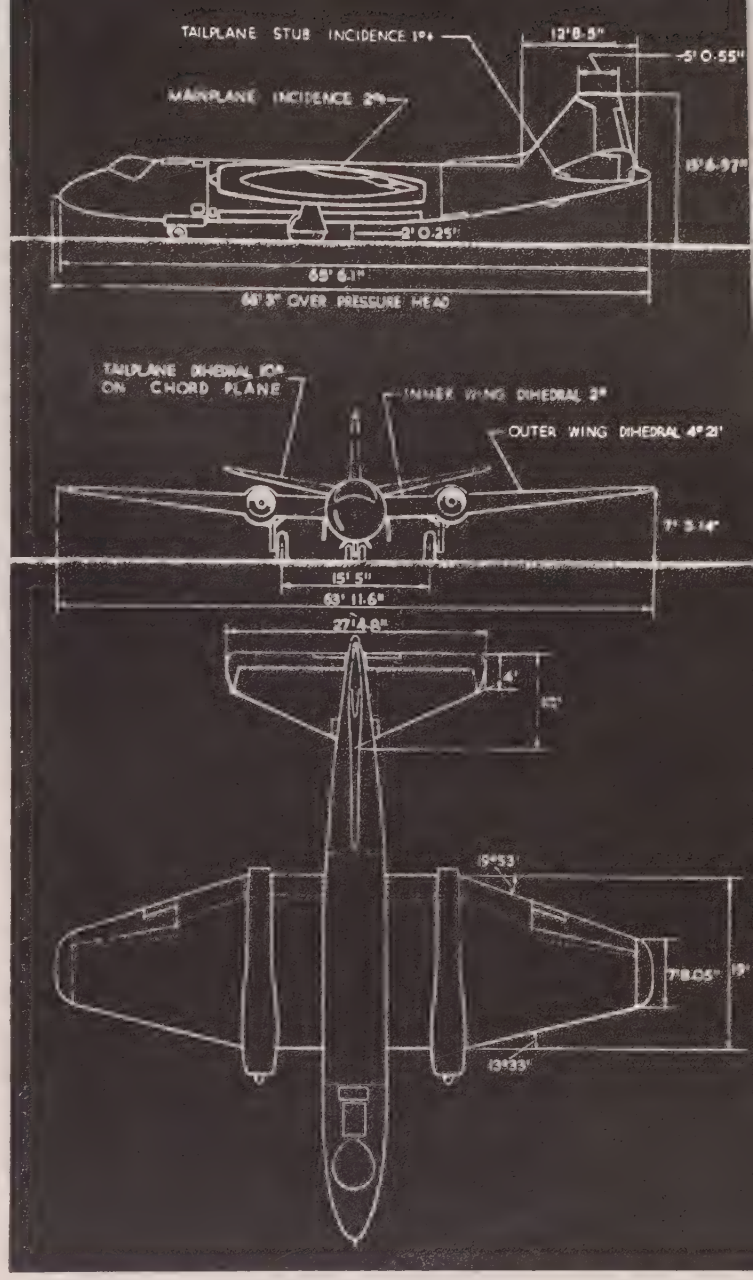
Every few years a combat airplane appears that carries the hallmark of greatness. Looking back over the last decade, the F-51 *Mustang*, the B-29 *Superfortress*, the de Havilland *Mosquito* and the F-86 *Sabre* spring to mind as airplanes that, from the word "go," displayed that *something* which is the difference between a good, efficient combat machine and a world-beater. The *Canberra* is one such as these. From the day of its debut the *Canberra* evinced all the potentialities of an era-making airplane; rarely has such elegance been seen in an

offensive weapon. Conspicuous by their absence are the bulges and excrescences usually associated with airplanes of its class, and the *Canberra's* beautiful yet "powerful" contour speak eloquently of the extreme care that has been given to aerodynamic cleanliness.

The *Canberra* can best be described as an excellent example of advanced orthodoxy in aeronautical engineering and one of which the British airplane industry is justifiably proud. That the USAF has decided to order this airplane in quantity is proof that this pride is not misplaced, and this epoch-marking decision is a compliment to British aviation design, the *Canberra* being the first British-designed airplane to be built in the States since the last DH-4 rolled off the assembly line after World War I.

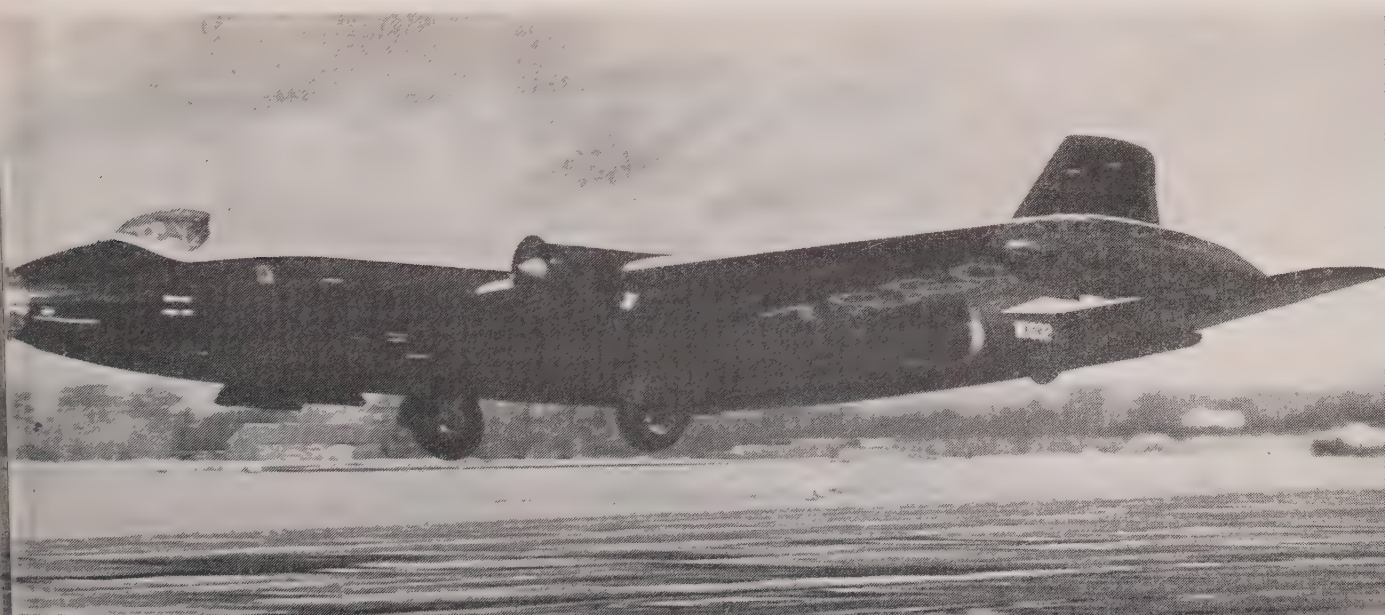
Until the appearance of the *Canberra*, it is unlikely that the English Electric Company will have been familiar to SKYWAYS' readers. Nevertheless, English Electric's airplane constructional history dates back over three decades. During the early 20's, a number of original designs emerged from the company's aviation department but, with the slump of 1926, English Electric left the airplane field until 1938, when the company's Preston plant received a contract to manufacture Handley Page *Hampden* bombers for the RAF Expansion Program. Orders for *Halifax* bombers and *Vampire* jet fighters followed and, gradually, a design staff was built up under the direction of W. E. W. Petter who, incidentally, besides being directly responsible for the *Canberra*, has designed Britain's second jet bomber to fly—a four turbojet built by Vickers-Armstrongs and bearing obvious traces of its relationship to the *Canberra*.

The *Canberra* first began to take shape on the drawing boards in 1944, when it was envisaged as a low-level fighter-bomber. However, changes in official views resulted in (*Continued on next page*)



GENERAL ARRANGEMENT of the English Electric *Canberra* is shown in this three-view drawing. Wing span is 64 feet

CANBERRA MK2 is the bomber version in which extensive radar was replaced by a third crew member: a bombardier



ROLLS-ROYCE AVON that powers *Canberra* is so compact that it is housed entirely forward of the wing's main spar

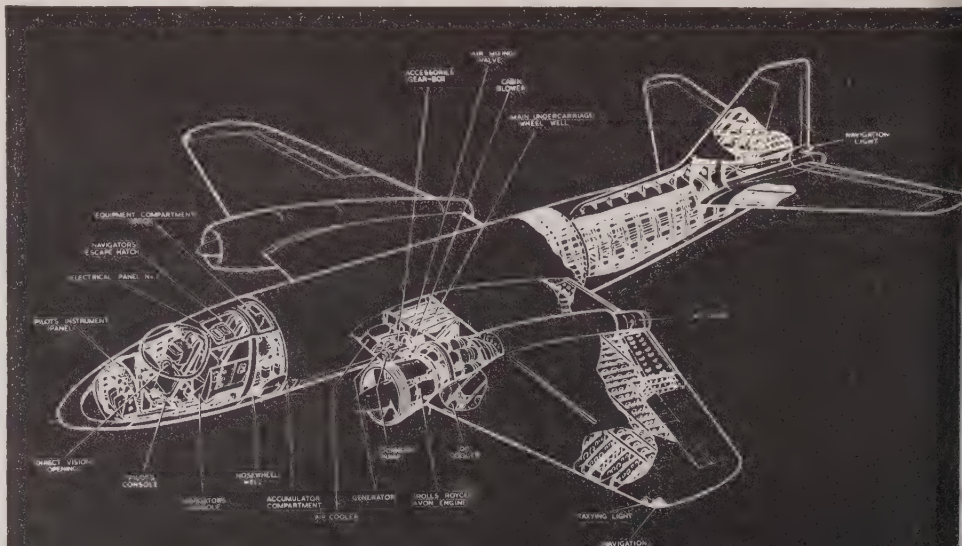
the issue of Specification B.3/45 which called for a high-altitude airplane relying on speed, altitude and maneuverability for its defense. This Specification outlined performance and load-carrying requirements, the auxiliary items the airplane was to embody, and specified the use of two Rolls-Royce *Avon* axial-flow turbines that were then in the early development stages.

The original design drafts were modified and it was decided that the technical solution to the requirements of the Specification was to be found in a combination of a light wing loading, comparatively low aspect ratio, smooth structure and modest thickness/chord ratio.

On May 13, 1949, Wing Commander Roland Beamont took the first prototype *Canberra* into the air from Warton airfield. Further prototypes followed in quick succession. The second *Canberra,* which was wheeled out on November 9, 1949, was experimentally powered by two Rolls-Royce *Nene* centrifugal-flow turbojets in place of the *Avon* axials. Although production of the *Nene*-powered *Canberra* was not envisaged, it was thought a good thing to have an alternative powerplant, should delays in the development of the then new *Avon* occur. However, *Avon* development progressed smoothly and the need to install *Nenes* never arose. The third and fourth *Avon*-powered prototypes flew within the next couple of months, and the *Canberra* quickly manifested a stability over the full cg and altitude ranges; its controls were sufficiently light and effective to give fighter-like handling qualities, and it possessed a quality almost extinct among modern jet bombers: a low landing speed.

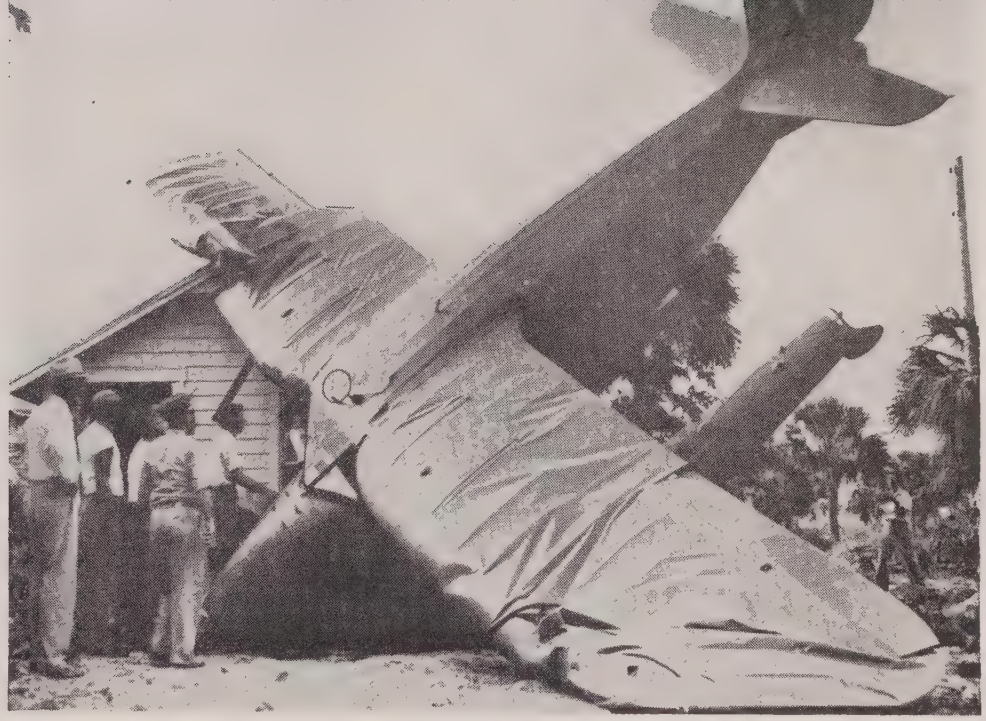
It was soon seen that the *Canberra* was amenable to adaptation for high- or low-level roles. Although designed primarily for high-altitude operations, it was found to be endowed with all the qualities necessary in a low-level attack bomber, among which a high degree of maneuverability at sea level is paramount.

The first four proto- (*Continued on page 37*)



CUTAWAY of the *Canberra* B MK1 shows crew compartment in nose, wing construction, engine installation in the wing, and rear fuselage details. *Avon* unit in the MK1 had 6,000-pound thrust rating; newer *Avons* in latter *Canberra* are rated "at over 7,000 pounds thrust"

Who Pays?



ACCIDENT liability? Plenty, if negligence is proved; none, if it was unavoidable

IN THE remote days of the first horseless carriage, the law—and the court as its interpreter—declared an automobile to be a dangerous instrument, and the driving of one a hazardous activity. The driver or owner of a machine that had caused injury to another or to another's property was adjudged liable absolutely for the damage. There was but one possible loophole of escape: this was the rare chance that the driver might be able to prove that his victim had been guilty of a contributory negligence which was responsible for bringing on the accident.

Gradually, this strict view as to the character and proclivities of the machine began to look a little absurd, however, and the enforcement of the legal rule as to absolute liability for damage or injury brought about injustices. A modification was, therefore, in order.

The modification came about in this respect: Court decisions established the general rule, followed ever since, that an automobile is not inherently a dangerous instrument if handled by a competent driver who exercises reasonable and ordinary care. Along with this modified view came the modern rule of the courts that the driver or owner of an automobile involved in an accident is not liable for injury caused another in person or property unless the damage inflicted arose from some defect or disrepair of the vehicle, or carelessness amounting to negligence in driving it.

When the airplane came along several years later, it went through similar bad times in the courts and in legislative halls. It, too, was regarded as "a dangerous instrument." Operating it was considered a dangerous performance, with resulting liability for damages accidentally inflicted, and no defense permissible, except for the right of one sued for damages in an accident to show, if he could, that the victim had been guilty of some negligent act that played a part in bringing on his own injury or damage, whichever was the case.

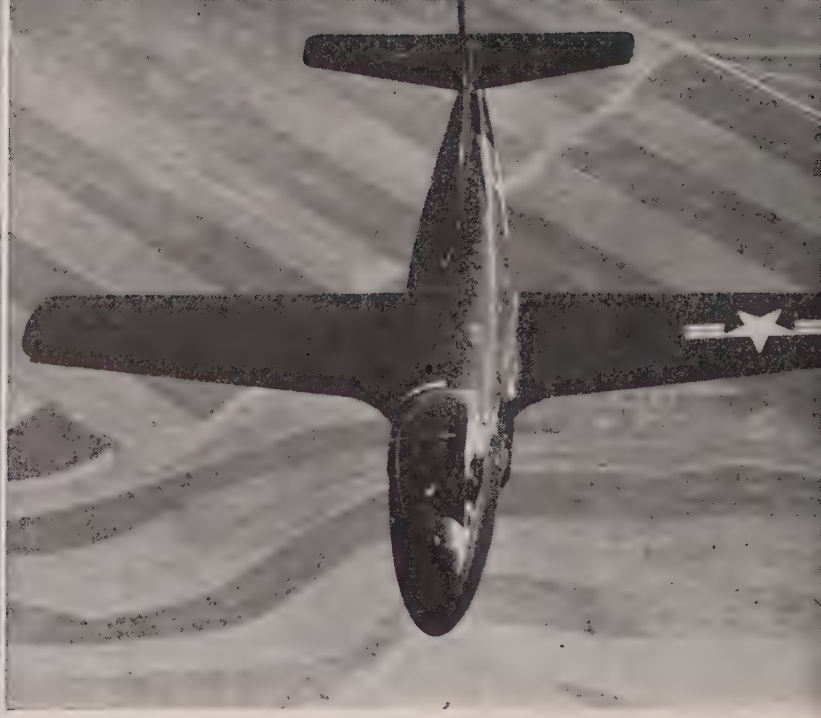
Courts and lawmakers remained firm in this fear-inspired attitude until the late '40's. Then they began to take the view that the operation of an airplane was analogous to that of an automobile, and that when accidents occurred and injury or damage was inflicted, the same legal rules should, in general, determine the rights and liabilities of the involved parties.

These preliminary explanations are pertinent and essential to a clear appraisal of accident liability. They are not only the foundation of the rules by which courts impose or deny liability against the owner or pilot of aircraft for damages in an accident, but the reasons behind those rules.

Confining the discussion to the ownership and operation of aircraft, with special reference to the renting or loaning of it to another, it should be said at the outset that *neither owner nor pilot is financially liable to anybody for injury or damage inflicted through an accident that occurs without negligence on the part of one or the other of them.* In other words, *there is no liability for an unavoidable accident.*

If a pilot, while operating a plane which he either owns or has rented or borrowed from its owner, commits such act of negligence with it as to injure or damage another in person or property, he is liable to the victim for all loss and damage directly attributable to his negligence. The sole chance of his escape from a judg- (*Continued on page 40*)

By RENZO DEE BOWERS

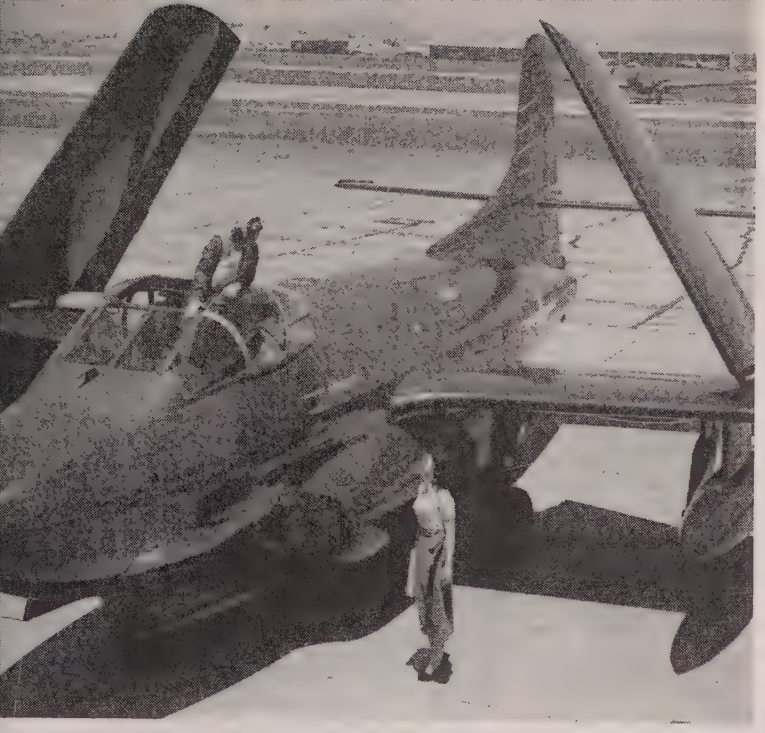


RADAR operator Murl Benefiel *(left)* hands Cmdr. Richard E. Harmer poop sheet on a mission in the F3D

SKYKNIGHT is a two-place night-fighter that was designed to be a night-fighter, not adapted for it

NAVY night-fighting training began in 1942. Today Navy airmen are training in the radar-laden F3D

Air Navy Night Fighters



DOUGLAS F3D is a 600-mph airplane built around a half-ton of radar equipment. Pilot and radar operator sit side-by-side, eliminating need of inter-com sets

SKYKNIGHT zooms past a GCA truck during daytime carrier approach practice

NIGHT-FIGHTER pilots *(below)* are briefed before night mission by Lt. Cmdr. Henry, just back from Korea. Men are undergoing training at Moffett Naval Air Station

By GIL CLOSE

Sleek and supple, bulging with high explosives and with a keen radar brain beneath its flat windshield, the Navy's new Douglas-built F3D *Skyknight* night-fighter is now priming for early action in the Pacific. A single glance at this airplane would make Uncle Joe turn over in bed, indulge in an eerie communal nightmare and exude quantities of cold sweat. It's a killer that strikes at night. It penetrates with ease the curtain of darkness under which man and animal has crouched for protection for centuries. It's the culmination of a series of operations, research and events about which the general public is little informed. So let's start at the beginning. . . .

"I have a customer for you."

These radioed words were common in the ether over the South Pacific at night during the later phases of World War II. After this introduction, if things went well, a "splash" followed.

In simple language, a "splash" meant that a night-flying enemy airplane had been intercepted and shot down. It meant that the Navy's newest additions to its air power, the night-fighters, were up there in the darkness using radar eyes to pounce and kill. It meant that "Washing Machine Charlie" and his irritating night raids over Guadalcanal were through.

"Splashes" became more regular as the war progressed, but some battleship admirals were hard to convince. One of them said to a night-flying airman, "You use your night-fighters in the next war. I'll use my anti-aircraft guns now." A few nights later, an intercepted Jap bomber plunged like a flaming meteor into the Pacific just off his prow. The admiral changed his mind.

Night fighting was born (*Continued on page 42*)

Sure Service for Seaplanes

ATTENDANT should moor plane in such a position it can't be swung into obstruction by wind

Service is a magic factor at airports and seaplane bases. Provide good service for both planes and pilots, and you —the proprietor of the base—will be among those at the deposit window of the local bank. The better the service, the greater the number of customers . . . . and the more money in the bank. It's a circle that's vitalizing, not vicious. Cues on good service are shown in these photographs offered by Gulf Aviation. Gulf's Service plan is in full swing at many a successful seaplane base where pleased customers like what they get and come back for more.

SEAPLANE approaching base, attendant hand-signals pilot to safe mooring into the wind

SEAPLANE BASE should be equipped with dollies, ramp, etc., to facilitate proper over-night docking of the seaplane

PLANE check is important. Attendant should inspect pontoons for water leakage; if water is found, pump it out

SALT WATER causes corrosion. Part of service includes good fresh-water wash down for a plane used on salt water

VISITOR PILOT set to go, attendant should warn of any obstacles in vicinity, then aid in swinging plane to open water

'Copters in Combat

FLYING EGG-BEATER has chalked up long list of rescues. Patient in stretcher *(above)* is being flown to safety

KOREAN WAR has proved value of the helicopter. Hundreds of wounded GI's owe their lives to the rescue 'copters

By T/SGT. EDDIE E. EVANS, USMC

PINNED down by heavy enemy fire, the Marine rifle company fought desperately to stave off defeat. With their ammunition rapidly being exhausted, the company commander realized he had to have help—but fast.

Speaking into the phone he said, "We need ammunition immediately, and have casualties that must be evacuated to safety." The battalion commander, quickly evaluating the situation, replied, "Help will be there in 10 minutes—I'm sending helicopters."

On the Korean battle front, the word "helicopter" has a magic ring to it.

Under these same conditions in World War II, Marines cut off from other units of the battalion would have been isolated because it would have been impossible for ammunition bearers to move forward. Thanks to the "flying egg-beater," this impossibility doesn't exist today.

The battalion commander, shortly after receiv-

ing the company's urgent call for supplies and help, readily complied by loading the necessary ammunition aboard a helicopter which delivered it directly to the isolated Leathernecks, enabling them to hold their positions until reinforcements arrived. The helicopter not only delivered the sorely needed ammunition but it also removed seriously wounded Marines to rear areas for treatment and evacuation.

Thus it goes. The Marines, long famed for their versatility on land, sea (*Continued on page 44*)

FRONT LINE transport is another 'copter accomplishment. Here, Marine General Cates and his aide get ride to Hq.

LEATHERNECKS of First Division in Korea welcome helicopter. It carries in supplies, carries out the wounded

MARINES at the Corps School in Quantico get ready to load aboard a helicopter troop carrier prior to test assault on fortified field position in maneuvers. This Marine helicopter is well-known Piasecki HRP-1 transport

RADIO, on left of *Navion* 260 panel *(below)*, plays important part in X-C navigation; use it to check weather

WEATHER CHART may show destination clear, but be sure to have alternate airport in case unexpected happens

X-Country Flight

NIGHT FLYING ability can add hours to your day and take the strain out of of trying to beat the sun. Pilots who do business flying will find it pays to get checked out at night. Being able to fly at night can come in very handy

Here are flight tips on easier cross-country contact flying

By V. A. PREVETTE

I TOOK a friend of mine cross-country recently in my new plane. I was real proud of the ship and couldn't understand my passenger's very evident fidgeting. "Come on, Russ," I said when we had landed at our destination, "what's the matter? Don't you like the ship?"

"I do like the ship . . . very much," he replied, "but, frankly, your cross-country technique drives me crazy."

Strange as it may seem I was relieved. After all, my flying could be fixed. "Okay," I replied, "I'll take a lesson; you show me on the return trip tomorrow."

AUTHOR and his companion did not fly an airliner, but modified airline techniques improved their cross-country speed and made the flight more profitable and more fun

He waved his arms at the gas truck. "We'll take the first step now." The plane was gassed up, the gas bill paid and a receipt obtained.

"Might as well get this done while we're waiting for our cab," he explained.

I saw the time saving effected the next morning. All that we needed to do was to line-check the airplane quickly and step into the cockpit. After an engine check and warm up, we were ready for take-off.

Russ took the ship out of the traffic pattern at a slow cruising speed and with a minimum amount of waste motion. This saved quite a bit of time, compared to my customary drawn-out meandering out of the pattern. As soon as he was clear of the pattern, he began a smooth climbing turn toward our heading. He used cruising speed in the climb. This made the climb shallow but resulted in our maintaining our speed almost from the take-off.

Once cruising altitude was reached, Russ told me he had picked this particular altitude after getting the winds-aloft reports. I remembered his calling the airport weather station before we left the hotel.

"No use plodding along down low if more favorable winds can be found higher," he told me.

The altitude selected was 4,000 feet. Once the altimeter needle hit 4,000, it did not deviate. Russ took pains to get the ship trimmed exactly on cruising speed in order that it might do the work for him in maintaining constant altitude and airspeed. He explained that when you constantly change altitude you not only actually travel a greater distance but do not maintain the best angle of attack. The angle of attack is important in that at the most efficient angle there is less drag and the propeller meets the relative wind at a more efficient angle. Even though your change of altitude is slight, over a period of time it can steal many minutes and make quite a difference in your time en route.

I noticed that Russ' choice of speed was exactly "recommended cruise." I asked him if that was an infallible method of choosing cross-country cruising speed.

"On this ship, yes," he replied, "but in some ships if you flew at the advertised cruise, you would radically shorten the life of the engine."

"Why is that?" I asked.

"It's a matter of sales appeal," he admitted. "Though their planes may be the safest and most practical for many (*Continued on page 46*)

Are the REDS Planning Air Invasion?

SOVIET IL-12 is one of most widely used military transports in Red Air Force service. It is powered by two 1,850-hp engines

ANTONOV glider is one of Russia's heavy military gliders developed as aerial freight cars for airborne operations. The Yak-18 *(left)* is a light transport and crew trainer, possibly could be used as glider tow plane, paratroop carrier

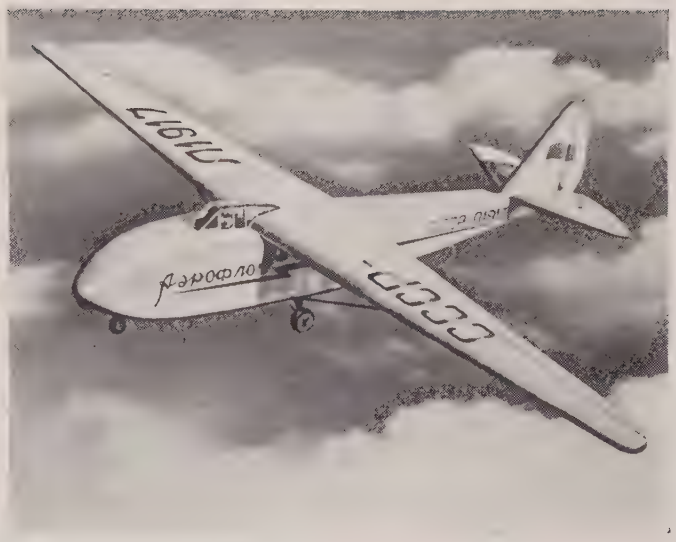
By WILLIAM GREEN

FORMATIONS of military transport airplanes towing heavy gliders, and large-scale drops of parachute troops have now become regular features of the spectacular Air Parades held twice a year over Tushino airfield, near Moscow. Much to the gratification of assembled Muscovites and "fellow traveller" air attachés who remember well the huge Anglo-American airborne invasion of the

Channel Coast, these items indicate the Soviet High Command has not excluded the possibilities of mass airborne assault in the planning of its future strategy.

Although these "shop window" displays give no conclusive evidence of what is going on within the vast structure of the Soviet military forces, recent evidence assembled by European Intelligence shows that the Reds are making their most strenuous effort yet to create an airborne army large enough to undertake decisive operations in the event of an open clash between East and West.

A favorite Communist bogey of pre-World War II days was the vast paratroop formations said to be available in Russia, all set to inundate neighboring states. The Russians, in fact, "invented" paratroops, forming the first small Red Army airborne



TROOP GLIDER that may be designated KTs-20 is of all-wood construction; and carries 24 to 30 equipped troops

ILYUSHIN 18 (IL-18) is believed to be a scaled-up version of IL-12. It is powered by four 1700-hp ASh-82 engines, has range of 1,854 miles. The Shche-2 *(right)* is a twin-engine paratroop trainer and light transport

formations way back in 1930. By 1936 these preliminary cadres had mushroomed into a sizeable force, unique by the standards of the time.

British military observers who witnessed the Red Army maneuvers at Minsk in '36, during which a drop was made in brigade strength, commented on the efficiency and toughness of the paratroops employed and on the surprising lack of casualties. These airborne troops were hand-picked men, the élite of the Red Army, and by the beginning of World War II, their num- (*Continued on page 44*)

LARK, a flak missile (Surface-to-Air) developed by Fairchild, is shown *(above)* on launching ramp. Anti-aircraft guided missile *(right)* zooms up in cloud of exhaust gas in firing test

Weapon of War: the Guided Missile

By BILL FRIEDMAN

One of the least understood of all the destructive vehicles in modern armory is the guided missile. The fables of its prowess have outstripped its development by a fantastic amount, enough to worry even those who are charged with the job of defending the cloistered secrecy in which these developments, perforce, must grow. If all the tall tales about guided missiles were true, one might believe that they could streak to the antipodes and locate an ill-starred housetop with an archangel's accuracy,

that they could course a bomber to its doom like some celestial staghound or dive like some supersonic cormorant to spear a submarine hundreds of feet underwater.

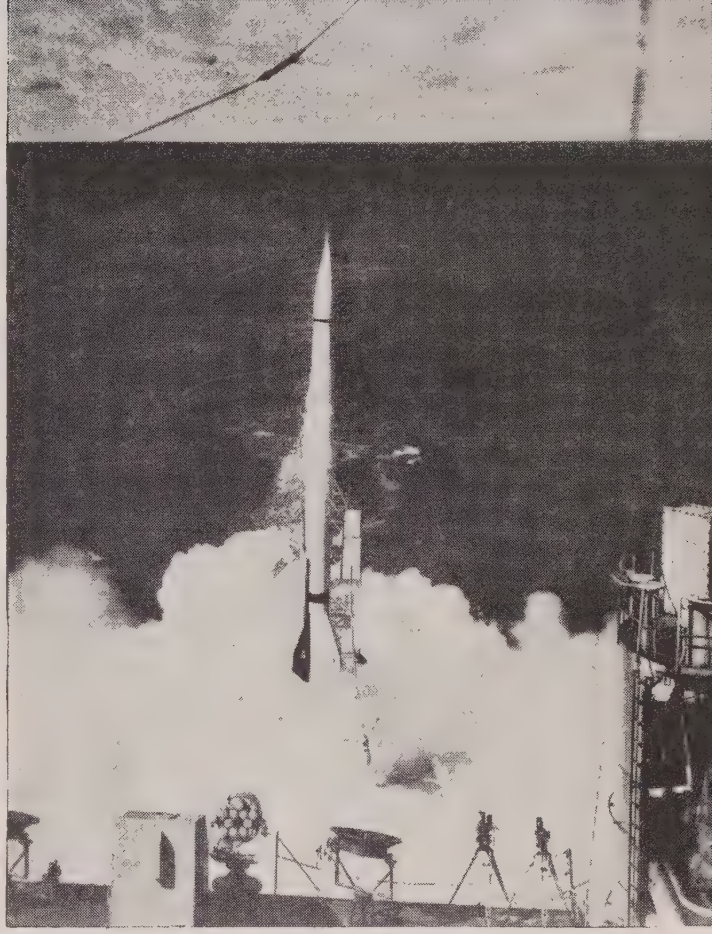
For obvious reasons, the details of guided-missile development are not public domain. However, if we have to live with this strange menagerie of flying things, it would be well if we all learned at least the A-B-C's of the craft that made them possible, the language by which they are described and the potential for good or evil that they represent.

Professor Hermann Oberth, noted interplanetary rocket experimenter and the main designer of the German V-2 (A-4) missile defined a guided missile as an "unmanned vehicle moving above the earth's surface whose trajectory or flight path is capable of being altered while in flight."

It differs from the ordnance rocket in that, after launching, its direction and sometimes its speed can be controlled in response to various kinds of human, mechanical or seeking-and-sensing guidance.

Subject to this definition, the earliest guided-missile system dates from about 1925. It was suggested by certain German scientists that an anti-aircraft system, more efficient than ordinary ordnance, could be developed by tracking the approaching aircraft with a searchlight and attacking it with a rocket rigged to follow the light beam. Selenium cells were to be fitted into the rocket's four control surfaces. If the rocket deviated from the center of the beam, one control surface would be illuminated more than the other. This difference in intensity could, through a transmission system, be applied to the control surfaces to aid in re-centering the rocket onto the beam. As long as the ground crew could keep the beam on the approaching aircraft, interception was inevitable.

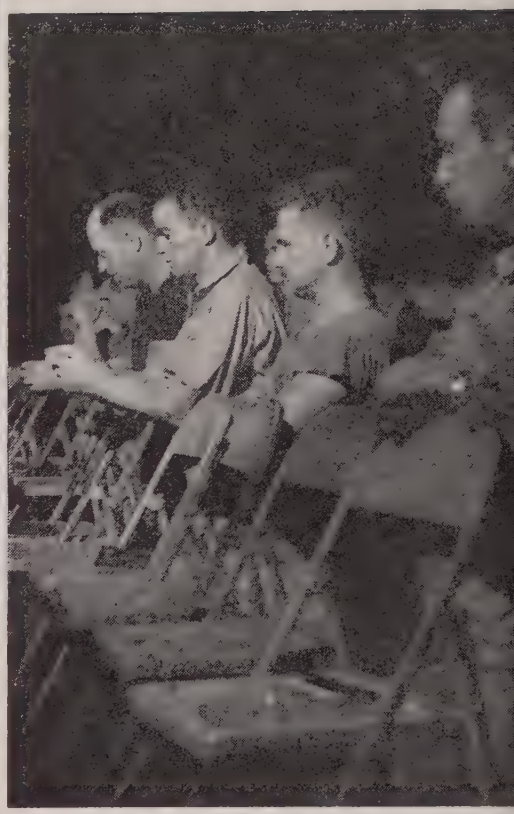
The pre-war ancestors of the modern guided missile, however, were interplanetary dreams for the most part. Dr. R. H. Goddard's early work with the bi-fuel rocket engine in a (*Continued on page 48*)



VIKING *(above)* was developed by Martin Co. It is high-altitude single-stage research rocket. On this firing, it went up 106.4 miles. German scientist Dr. Roth *(below)* now works for the U.S. government at its experiment station in New Mexico

LOON is a Surface-to-Surface missile, a modernized V-1 offering better guidance. Here, it is being launched from submarine

DAY on a carrier begins early and, of course, starts with chow. Here, T/Sgt Leo Ihli *(above, right)* breakfasts with T/Sgt. M. I. Fredericks of Menlo Park, Cal. Twenty-seven-year-old Leo Ihli is a native of Sisseton, S. Dak.



CHURCH services and prayer are daily need of fighter pilots and aircrewmen facing enemy action. T/Sgt. Ihli attends Rosary with other carrier men prior to the call to Flight Quarters and the take-off against Commies

Flattop Fighter

A DAY in the life of a Marine Corps fighter pilot was recorded recently when photographers mate second class R. G. Jenkins, USN, took pictures of T/Sgt Leo J. Ihli, USMC, as he prepared to fly a combat mission over Korea, and on his return to his carrier, *USS Badoeng Strait.*

T/Sgt Ihli is a native of Sisseton, S. D., and he enlisted in the Naval Reserve for flight training immediately upon his graduation from high school in 1942. In the meantime.

FLIGHT QUARTERS station is in ready room. Ihli makes notes during mission briefing

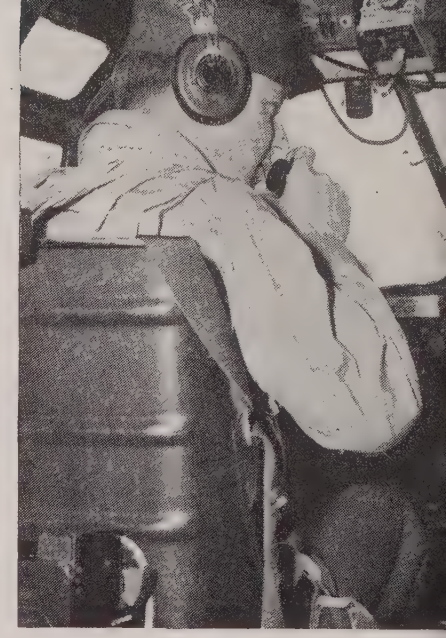
PILOTS, man your planes! T/Sgt. Ihli flies *Corsair* Number 5. On the "cat," he is set to go for another air strike against Chinese Communist strongholds in N. Korea. Ihli won his wings in 1947

ATTACK by Ihli and his squadron mates knocks out important Communist supply area in Seoul. After almost daily air blows by both Marine and Air Force fighters, Seoul was taken by the U.N. ground forces

MISSION accomplished, Ihli makes a "Roger pass" and prepares to take "Cut" signal from the LSO

Leo's father had joined the Marines and was commissioned a captain. When the Navy accumulated an excess of pilots before young Leo could finish his flight training, the Navy honorable discharged the boy, but a month later he enlisted in Captain Leo's Marines and again applied for flight training. This time he went all the way, and in 1947 the gold wings were pinned on his shirt. When T/Sgt Ihli's squadron was alerted for Korean action, it was based at El Toro, Calif. Since arriving in Korean waters, Leo has flown almost daily missions against the Commies.

HAND TALK is universal pilot language. Here, Leo and another fighter pilot talk over the mission



NAVY pilot V. F. Martensen *(right)*, at the controls of a Twin-Beech, contacts the tower for taxi and take-off instructions. At end of transmission, it will be closed with "Out," not "Over and Out"

TOWERMEN control air traffic from their perch atop this steel structure *(left)*, and have no love for airmen who leave keys open, who garble messages, use fancy oral didoes and clutter up the air

Over...But

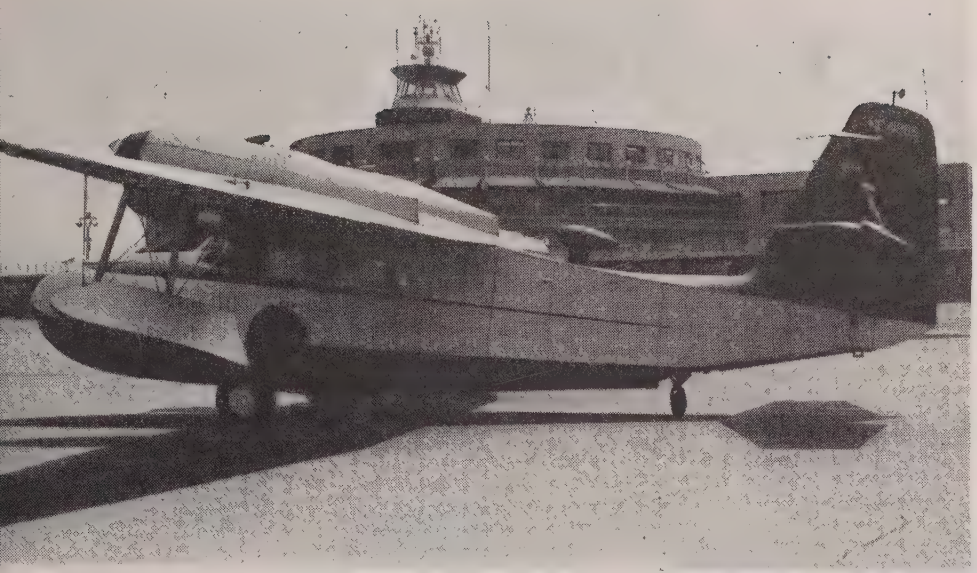
By H. P. GREELEY

Aircontrolman, USN

EVERY once in a while a movie comes along in which the pilot of an aircraft seems to be having a tough time contacting the control tower at the airport where he intends to land. Generally, the tower operator himself seems to be having quite a time of it—beads of sweat appear on his forehead, he gets tangled up in his earphones, and screams in high falsetto tones, "Come in, please." A look on his face seems to say that he, personally, has given up all hope of ever hearing from the pilot again, much less ever seeing him.

We protest! "We" are that small group of individuals who make a living controlling air traffic from an airport control tower. From what we have heard, the fellows who operate radio range stations for CAA feel the same way.

Recently, I read an aviation story in a well-known national weekly. The author did a fairly respectable job from a technical standpoint, but along toward the end of the piece the "hero" had occasion to call another plane on the ground. So, does he say—as any pilot halfway checked out on radio procedure would do—"NC so-and-so, this is NC so-and-so, over." He does not! Instead, our "hero" clutters up the air with a lengthy discussion of everything but the color of the instrument panel, and ends up with "Come in, Joe Doaks, over and out."



WIDGEON pilot *(left)* contacts control tower at LaGuardia Field, N. Y. for ATC clearance. He will do himself and tower a favor by repeating clearance verbatim, then closing transmitter after he has finished talking

AIR TERMINALS that are busy employ more than one aircontrolman. One controller handles all ground traffic, while another concentrates on in-flight traffic. The two towermen usually alternate to relieve the strain

Not OUT

To the layman this complaint we are making may seem slightly ridiculous. It may amaze some people to know that there is a definite set phraseology which is approved by the FCC for air-to-ground communication, and it *does not* include "Come in, please." A transmission is ended with the simple word "Over," if it is intended that the person transmitting is to stand by for a message from the other party concerned. If, on the other hand, no further communications are anticipated in the near future, the message is ended with "Out." That's all. *Not* "over and out," as Hollywood and some magazines would have civilians believe. Just plain "Over," or just plain "Out," but never the two combined.

Usually, a control tower is a busy place. We try to keep our conversations with pilots down to just the information requested. While we try to guard against being too telegraphic, we are too busy to sweat out any one aircraft after we have given the pilot take-off or landing instructions. After all, the pilot had to be a pretty smart character to get through cadets and start flying for the Navy, Air Force, or what have you; and we assume that he knows what he is up to.

Fiction stories and movies would lead the public to believe that once an airplane is above an overcast it is a dead duck. Nothing could be farther from the truth. In fact, once a pilot starts a standard range approach, or is talked in by GCA, he is as safe as he would be in his mother's kitchen; provided, of course, he doesn't forget everything that has been (*Continued on page 54*)

AIRCONTROLMEN for the Navy, here on duty at NAS Whidbey Island, are author Greeley *(left)*, and L. E. Johnson

FOLLOW ME reads the sign on the door of this Piper *Super Cub (above)*, one of a fleet of *Cubs* now on constant patrol around the Hanford, Washington, atomic energy works. The *Cubs* ride herd on suspicious cars in the vicinity

NORTHROP INSTITUTE students put the finishing touches on a unique four-burner turbojet designed and built by the boys in training at the California school. The engine features an unconventional centrifugal compressor arrangement

PANTHERS knife through skies over the sea of Japan near Korea. These Grumman F9F's are based aboard fast carriers of Task Force 77 and have been striking swiftly in attacks against Reds

Air News

CESSNA 190 *(left)* belongs to Dr. A. E. Scotoni, well-known Swiss sportsman and businessman. This photo was taken by a pilot in another Cessna as both planes flew alongside 14,000-foot Jungfrau peak

THUNDERJETS presented to the French Air Force by the U.S. are shown here lined up along a runway at the Reims airfield

NON-STOP RECORD, Los Angeles to New York, was recently set by Max Conrad in his Piper *Cub*. Time: 23 hours, and 4 minutes

COMETS fly in echelon formation above clouds. These all-jet airliners are soon to go into regular BOAC air service

Operation Umbrella

AIRMEN of the 53rd Fighter-Bomber Squadron run for their planes on a "two-minute" alert to intercept "enemy's" raiding aircraft in area

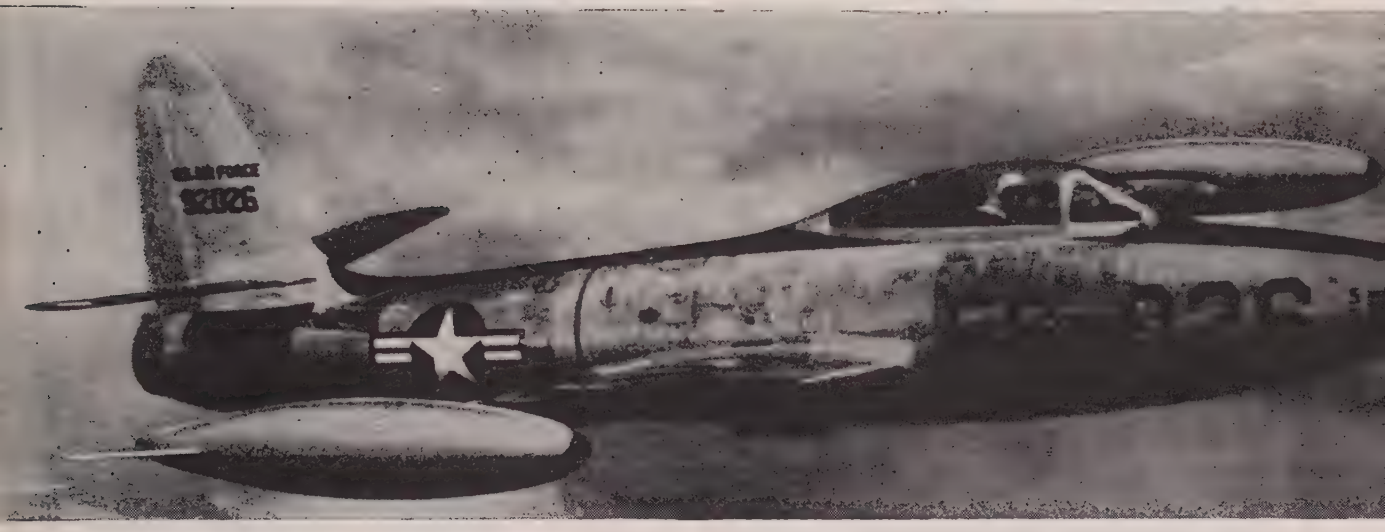
MECHS take it easy in front of a line of F-84's just prior to the opening of "Operation Umbrella." F-84's are Republic-built jets

Reims, France: Members of Lt. Col. Curran L. Jones' 53rd Fighter-Bomber F-84 *Thunderjet* Squadron recently staged "Operation Umbrella" in the North Atlantic Treaty Organization's three-day exercise. The maneuver, first under the new Supreme Headquarters of the Allied Powers in Western Europe, utilized about 500 planes of the United States, England, France, Belgium, Denmark and the Netherlands, in a bomber attacking force which was to be intercepted by jet fighters. These photographs were taken during the "scramble" alert.

ALERT message that has just come over radio-teletype is checked by Major L. Webber, of Riverside, Cal. Sgt. *(left)* is Harvey Hall

RADIO operator Sgt. R. D. Mead *(left)* of Friend, Nebraska, mans a high-frequency mobile radio at a temporary base to maintain contact with the "Defense" Forces Headquarters

PILOT Lt. Donald C. Smith, of Marysville, Ohio, munches sandwich in his cockpit at ready line awaiting take-off signal. Mechanic at right is Sgt. James Shipman, St. Joseph, Mo.



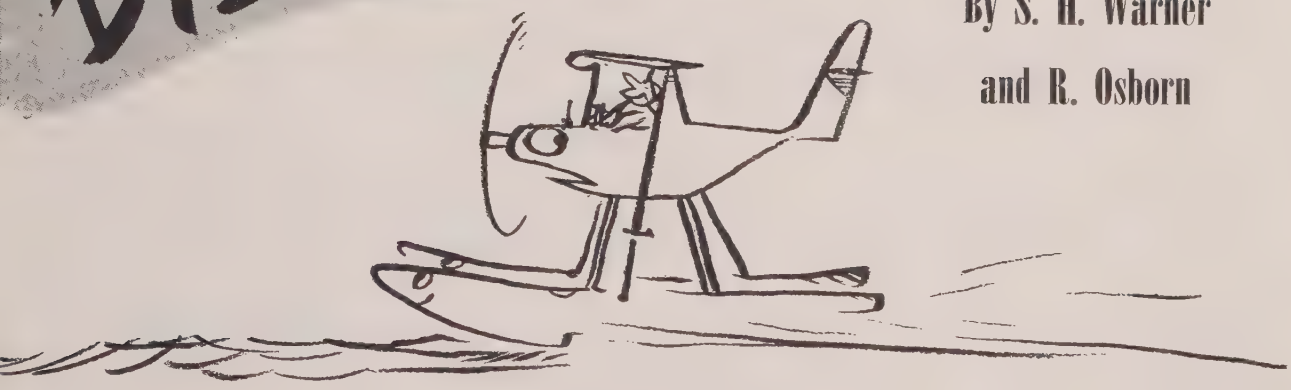
THUNDERJET is now in quantity use in European theater of operations. The jet-powered F-84's are now being delivered to nations of the North Atlantic Treaty Organization

JET FIGHTER *(below)* begins its take-off during the Alert for bomber interception in "Operation Umbrella". In foreground is an Air Force ammunition dispensing truck

"A good pilot is part of the plane he flies . . . a Dilbert's only part of a flyer"

DILBERT

By S. H. Warner
and R. Osborn



The Sins of Omission—Dilbert made a normal take-off in his twin-engine cargo job, then found he couldn't retract the port wheel. So he decided to lower the gear again and land to find out what was wrong. So far, so good.

The right wheel and the tail wheel lowered and locked easily, but considerable pumping was necessary to get the left wheel locked. While circling the field, Dilbert tried to lower his flaps manually, but could get them down only 10°. He decided to make a no-flap landing in order to save the remaining hydraulic pressure for braking. Still on the ball.

During the landing run, his flight engineer pumped continuously on the hydraulic pump in an effort to maintain brake pressure. Good, good! But the brakes failed completely about 250 feet short of the end of the runway. The plane nosed over when she hit soft sand. Oh, oh! Not so good.

The airplane wasn't demolished; 10 days and $5,000 later it was back in the air. Only this time Dilbert was not the pilot. Much to that young man's surprise and chagrin, his boss claimed that he, Dilbert, was entirely responsible for the accident. The boss admitted that Dilbert handled the emergency correctly as far as he went, but loudly insisted he didn't go far enough.

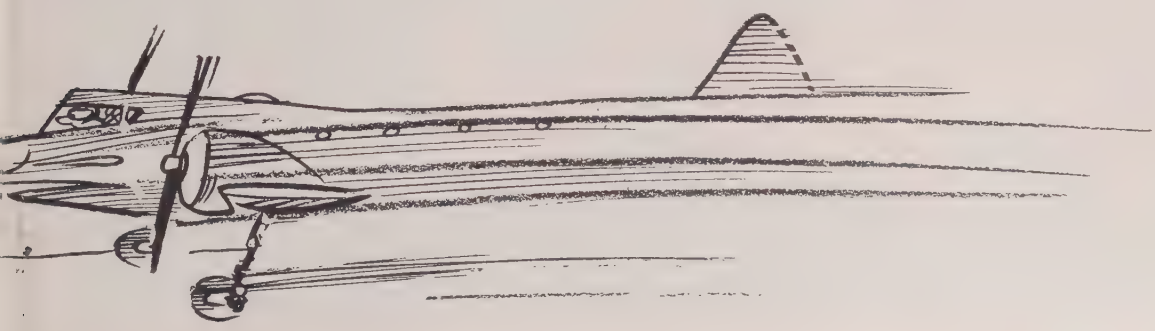
It seems this airplane was equipped with an emergency brake system and, as the boss pointed out with considerable heat, "It was installed for exactly such an emergency. But it isn't worth a damn unless used."

The net result of all this was the terse and clearly to the point ad suggested for display in an early issue of a magazine:

POSITION WANTED—Pilot with 950 hours flight time. Can and will fly anything anywhere. Wealth of experience with emergencies. Box 10, SKYWAYS, or phone and ask for Dil.

Take Oxygen—Not Chances—Some people don't understand all they know about using oxygen in airplanes. For instance, they can't seem to get it through their brainpans that it is necessary to "take" oxygen above 10,000 feet; above 5,000 at night.

"Don't be silly," they (*Continued on page 50*)



TAYLORCRAFT TOURIST is a four-place personal plane powered by 145-hp Continental engine. Deliveries start in about 90 days

New for the Private Pilot

With today's emphasis on military aircraft, it's slim-picking for the private pilot anxious to see new personal planes on the market. However, here are two that hold much promise for the future. The Taylorcraft *Tourist* (*above*) is a four-placer powered by 145-hp Continental engine. It has top speed of 125 mph, lands at 36 mph, has cruising (115 mph) range of 500 miles, and is resistant to spins and stalls (will even climb at a low 28 mph). Cost: $5,950.

A few years ago private pilots in the U.S. were enthralled by the French jet Fouga *Sylphe* (formerly called *Cyclone*). That same company has come up with another jet private plane, this one a twin-jet *Gemeaux* (*Twin-Mustang*, French style). Powered by two *Pimene* engines developing 240 pounds static thrust, the *Gemeaux* cruises at 186 mph (124 mph on one engine), has a two-hour range.

FOUGA GEMEAUX is a twin-jet sportplane now undergoing flight tests in France. It is powered by two Turbomeca *Pimene* jet units

LIGHT PHOTO shows off sleek lines of the English Electric *Canberra* Mk 2 bomber powered by two Rolls-Royce *Avon* jet engines

Design Report: Canberra

(*Continued from page 12*)

pes were B. Mark 1's: two-seat high-alti-de tactical bombers equipped with compre-ensive radar bombing aids in the nose. owever, delays in the production of the ecessary radar led to the development of e B. Mark 2 version in which a third crew ember, a bombardier, replaced the nose dar. This variant is now rolling off the glish Electric assembly line at Preston in ever-increasing flow, and the first RAF *nberra* light bomber units are now receiv-g their planes. Other British plants, includ-g A. V. Roe, Short Brothers and Harland, d Handley Page, are tooling up for the ass production of the *Canberra*.

The most recently revealed version of the *nberra* is the P. R. Mark 3, a high-altitude otographic reconnaissance airplane. Cur-nt reports indicate the development of still nother model: a heavily armed attack ver-on, concrete evidence that the *Canberra's* ement is the sky, irrespective of altitude.

The version to be produced at Glenn L. artin's Baltimore plant as the USAF B-57A, ll be a heavily armed night-intruder plane. nlike the present British production ver-on, it will probably be a two-seater and it likely that American-built J-65 *Sapphires* ll replace the *Avons* presently installed.

Within the framework of the British Air inistry Specification B.3/45, W. E. W. Pet-and his design team evolved an airplane at was thoroughly rational in concept. ithout resorting to marked wing sweep-ck, high wing loadings or futuristic ap-arance, they achieved a triumph in clean rodynamic design that puts to shame many esent-day jet fighters. The question of eepback was, naturally, given very serious ought, but its advantages were found to be outweighed by those inherent in the type wing chosen. For an airplane of the *Can-rra's* size, wing turbojets would largely llify advantages gained from wing sweep, d the low-speed flying characteristics re-quired by the Specification could not have been attained. At this point it is of interest to note that the critical Mach number of the wing has been very considerably exceeded on numerous occasions without the usual concomitant pitch change.

Structurally, wing thickness of the *Canberra* was virtually determined by the necessity to stow the mainwheels of the undercarriage in the wing. Consequently, aspect ratio was influenced by the required wheel-stowage depth and the aerodynamic factors setting an upper limit to the thickness/chord ratio. The aspect ratio chosen was 4.3, the span loading approximating roughly that used for modern jet fighters with an aspect ratio around 6.

Wing design of this kind offered numerous advantages: a very high degree of maneuverability, especially at extreme altitudes, was afforded; low-speed handling, approach and landing characteristics are of an unusually high order, and the stall is gentle and completely viceless. The speed ranges attainable are superior to any comparable airplane in the world.

The airfoil section of the *Canberra* is a modification of a German contour, designed to give a reasonably high critical Mach number without sacrificing high controllability. The symmetry of the mainplanes avoids violent pitch changes when the critical Mach number is exceeded.

The wing is of monospar structure with a sectional rear wall. An unusual design feature is that no conventional center section is employed, the wing spars being joined by a bridge member spanning the fuselage, fork/lug style connections being made direct to the boom ends with double horizontal pins, top and bottom. Inboard of the *Avon* nacelles and forward of the main spar, the wing structure is, in reality, a faired stowage box which houses various auxiliaries and the main undercarriage members.

Wing leading-edge structure comprises main ribs with plate webs and extruded booms, flanked on either side by smaller sub-ribs. The skin-strengthening extruded stringers run intercoastal to the main ribs and over the sub-ribs, and the manner of attaching the stringers to the sub-rib booms is unusually clever. This comprises a miniature eye-bolt, pivoted to the stringer web and screwed to a small anchor cleat, riveted to the rib. The main chordal ribs between the main spar and the rear wall, or auxiliary spar, have plate webs and extruded T-booms.

The control surfaces are flat-faced "wedges." A certain aerodynamic penalty must be paid by these owing to the lack of chordal curvature, but this penalty is negligible and of little consequence when compared to the advantages afforded by such surfaces in allowing for a high standard of inspection during manufacture; the simplicity of manufacture of these should also be taken into account. Both the inner and outer wing trailing edges are single-skinned on pressed-sheet ribs over the retraction recess for the split flaps.

The aileron shrouds are unusual in that the shroud surfaces are of wedge section with the feather edge forward. This is pianohinged to the sub-spar booms, the shroud gap being adjusted by shims under the stops of the adjustment points at each end and in the center: this system being employed as a result of a conviction that aileron effectiveness is largely dependent upon the quality of the shrouding.

The clean wing/fuselage junctions, absolutely free of fillets, are a remarkable example of the thought that has gone into every detail of the *Canberra's* design. The use of fillets is, in any case, almost habitual nowadays. In reality, fillets are a compromise with inefficiency and it is refreshing to see that, when properly designed, an intersection relationship such as that used by the *Canberra* does not require the assistance of fillets.

Most of the *Canberra* B. Mark 1 prototypes were fitted with the 6,000-pound thrust Rolls-Royce *Avon* R. A. 2's which gave a specific fuel consumption of about 1.00 lb/hr/lb. But the production *Canberra* B. Mark 2's and P. R. Mark 3's at present rolling off the as-

(*Continued on page 38*)

Rough-Field Landing Gear

Italian designer G. Bonmartini has developed a tandem landing gear for aircraft, in this instance a Piper *Cub*. Known as the Bonmartini Tubular Track Landing Gear, it enables a *Cub* to be taxied over a pile of stones on a landing field (*below*) as well as other natural dangers facing a pilot who has to land on unprepared ground. The flexibility of the pneumatic rubber track of the gear can be seen in the photo above.

Design Report: Canberra

(*Continued from page 37*)

sembly lines have 6500-lb thrust *Avon* R. A. 3's. Continued development of the *Avon* has led to further thrust increases and later production *Canberras* will probably have *Avons* of more than 7,000-pound thrust.

The *Avon* turbojet is so compact, even by normal axial standards, that it is housed entirely forward of the main spar. Some compensation for the cut-out in the spar web to accommodate the jet pipe is obviously necessary and this is given by the use of massive, cast bridging-rings which are through-bolted on the front and rear faces of the spar. The arrangement of the front attachment—swing-link tie-rods depending from hemispherical cup-fittings and pivoted to truss beneath the compressor casing—permits lateral and axial expansion movement of the engine forward of the main mounting points; axial expansion rearwards being accommodated in the jet pipe tunnel.

Drive from the *Avons* is transmitted to a Rotol Rolls-Royce auxiliary gearbox mounted in each wing leading edge: that on the starboard side having a generator, Lockheed pump and Hymatic compressor; the postside gearbox, in addition to its generator and hydraulic pump, has a Marshall cabin blower in place of the Hymatic compressor.

The removable cowlings of the *Avons* consist of a front cowl secured on a hoop and attached over the leading edge, main top and bottom removable panels and an underside service panel secured by four flush toggle fasteners which can be quickly removed to provide access for engine inspection and adjustment. Engine changes are accomplished by removing the detachable cowlings and lifting the engine bodily on a sling. Owing to all the auxiliaries being mounted on the previously mentioned gearboxes, there are very few connections to be broken down.

In marked contrast to the low aspect ratio wing, the *Canberra's* fuselage gives the impression of being inordinately slim whereas, in actual fact, the diameter of the central portion is no less than six feet.

Considerations of cabin pressurization led to the adoption of a circular section. Whereas the central fuselage trunk is a parallel cylinder, the forward nose section has been designed as a symmetrical ellipsoid although the circular section is maintained. The major axis of the body is inclined downwards, thus increasing the pilot's field of vision. The axis of the rear fuselage is actually a large-radius upward curve so that, while the circular section continues, the "spine" of the rear fuselage is a straight continuation of that of the central trunk portion. The "keel" line gracefully curves upwards to the tail cone, thereby affording appreciable ground clearance in a tail-down landing.

In conformity with the external design of the *Canberra*, a very high standard of interior layout is provided the crew. The nose of the present British production model, the B. Mark 2, has a transparent plastic nose fairing with an offset bombardier's sighting panel, but this will be deleted on the B-57A version.

The pilot's canopy is one of the *Canberra's* outstanding features. This is a double perspex dome, the 5/16-inch thick outer skin of which is separated from the 3/16-inch inner skin by a 3/8-inch cavity which is aspirated through twin packs of activated alumina desiccant. The anchorage of the canopy is provided by explosive bolts, so that the canopy can be jettisoned in an emergency. Its base width is 4 feet 6 inches, and its length is 4 feet 10 inches. A pair of submerged aerials are embodied in the canopy.

On entering the cockpit, via the floor hatch in the starboard side, one is immediately surprised by the workmanlike arrangement and the amount of space available to the crew. Settling into the pilot's Martin-Baker ejector seat, one finds that all instruments and switches are very neatly arranged. The control column is of "spectacle-headed" type. The machmeter is installed immediately forward of the "stick," with the blind-flying panel and engine-instrument panel on either side; auxiliary service instruments are installed on the right of the engine-instrument panel. Tailplane incidence control and indicator, and the main engine switches are fitted beneath the blind-flying panel, while the fuel cocks and throttles are installed at the forward end of an inclined shelf, left of the seat, together with flap-operation, rudder trim, bomb-door operation, hood jettison and control-column release switches.

The navigator's ejector seat and table are positioned aft of the pilot, with a jettisonable fuselage-roof section, incorporating a perspex lighting panel, forming an escape hatch. In order to give the necessary clearance in seat ejection, the bulkhead carrying the navigator's seat slopes some 20° backwards. This bulkhead is the rear diaphragm of the pressure cabin and for this reason (plus the fact that it carries seat loads and acts as an anchorage for the nosewheel leg) it is heavily grid-stabilized on its after face. The front and center fuselage sections join up some two feet aft of the pressure bulkhead. This joint is closed with another bulkhead, and between this and the pressure diaphragm is the nosewheel well.

The master unit of the autopilot, oxygen bottles and the hydraulic system reservoirs are stowed above the wheel well, and on either side of the well are (starboard) the ground/flight switch, the ground supply socket, voltage regulators, etc., and (port) VHF equipment, the air bottle and pre-

ization silencer and the Vokes hydraulic
er. Access to these compartments is gained
panels in the roof and sides. Accumula-
s are installed between the front/center
elage-joint bulkhead and the forward
nb-bay wall.

The bomb-bay doors, which are 22 feet 3
hes in length, are so designed that, to
en, they retract upwards and thus avoid
flow disruption occasioned by down-
nging doors. A forged bracket, centrally
oted to the fuselage, is bolted at each end
both doors, and vertically-mounted jacks
each end contract for door opening; as the
ks close, the doors are raised, each being
pported in three roller guide tracks.

The massive bomb-bay roof structure is
lt up on transverse beams of plate webs
h extruded L-booms to which intercostal
nnel beams mate fore and aft forming a
d skeleton which carries the tank bay
or plating. The tanks themselves are bag-
e crash-proof units but their capacity is
ject to security restrictions. These tanks
be supplemented by jettisonable wing-tip
ks.

About 2 feet 3 inches past the rear end of
bomb bay, the rear fuselage section joins
with the center section. The rear fuselage
a simple semi-monocoque, the channel
mes of which are notched for the extruded
tringers. The fin posts are attached to
ar-shaped semi-diaphragm frames which
e over from the channel frames at the
reme rear fuselage. A flat deck forms the
reme tail of the fuselage, across which
ses the tailplane which is anchored in pin-
nts to the rearmost pear-frame.

Like the wing, the tailplane of the *Can-
ra* is of relatively low aspect ratio, and
characteristics are such that, within the
pective limits of performance and travel,
airplane is completely stable for all con-
ions of altitude and cg position. A 10°
plane dihedral gives freedom from jet ex-
ist influence and reduces assymetrical tail
d when flying with one turbojet out.

The tailplane is built on a trapezoidal
ter-section, the front wall of which is a
ssive light-alloy casting uniting the spars.
sically, the tailplane spars are similar to
se employed in the wing, and chordal ribs
plate webs are set normal to the spars
notched for the stringers. The port ele-
or is fitted with a spring tab while that
starboard has a normal balance tab.

An English Electric linear actuator for
ying tailplane incidence is housed inside
tailplane center section. This actuator in-
es irreversibility of control under any
dition of flight; the variable incidence
ing positive control at high Mach num-
rs.

The fin is unusual in that it is made of
od, although normal spar and rib con-
uction is employed. Submerged aerials are
bodied in the structure.

Massive, forged triangulated anchorages
the mainwheel legs are fitted at the out-
ard rear corners of the front part of the
er wing in conjunction with the main
r. The main undercarriage units are of
glish Electric design and the heads of
oleo legs are carried at such an angle
t, in retracting, the wheels are raised with
forward swing to enter the wells in the
ng leading edge. The flush-fitting under-
riage doors are actuated by a separate
k through sequence valves and include
gle-operated positive latch-lock devices.

The nosewheel assembly has its leg pivoted to a pair of forged brackets bolted on the rear face of the pressure bulkhead, the radius strut and jack head being attached to the front/center fuselage-joint bulkhead, the twin-wheel unit retracting rearwards.

The *Canberra's* debut in the United States, coming as it did immediately after a record-breaking trans-Atlantic flight, could not have been arranged more spectacularly, with columns in the newspapers recording how the bomber was flown across the Atlantic without recourse to flight-refueling: the first jet-propelled airplane to perform this feat. The flight, more meritorious in having been made from East to West in face of strong headwinds that were encountered even at heights of 40,000 and 45,000 feet where the *Canberra* cruised, proved irrefutably that the airplane's performance and capabilities do not belie its aesthetic contours.

The trans-Atlantic *Canberra*, serial-numbered WD932 and carrying wing-tip and bomb-bay auxiliary tanks—the capacity of which have been the object of conjecture on both sides of the Atlantic—flew roughly a Great Circle course, not employing the pressure-pattern technique. Her track passed near two weather ships, one British and one American. The distance was 1800 nautical miles (2100 statute miles). Before take-off, the pilot, who was not allowed to divulge precise details of his airplane's performance, *did say* that each increase of 50 knots in headwind speed would add about half-an-hour to his flying time.

The rest of the story is well-known to our readers. The *Canberra* landed, having flown against strong headwinds, beating the previous best time for the Ireland-Gander trip (by a Pan American *Constellation* in 6 hours 40 minutes) by some two hours.

Ranking high among the most maneuverable jet airplanes in the world, the *Canberra* possesses an excellent turn of speed—the maximum speed of the *Canberra* B. Mark 2 is well in excess of the 580 mph quoted by some of our contemporaries, and its amazing climb and roll rate belie its 46,000 pound all-up weight.

When the B-57A goes into service with the USAF, taking over the duties now undertaken by the B-26's in Korea, it will form a fitting compatriot to the F-86 *Sabre*, F-84 *Thunderjet* and B-47 *Stratojet*.

Data for the *Canberra* B. Mark 2 and P. R. Mark 3.

Span	*63 ft 11.6 in*
Height	*15 ft 6.9 in*
Aspect Ratio	*4.3*
T/c ratio:	
Root	*12%*
Tip	*9%*
Incidence	*2°*
Length	*66 ft 3 in*
Gross Wing Area	*960 sq ft*
Standard Mean Chord	*15 ft*
Dihedral:	
(Inner wing)	*2°*
(Outer wing)	*4° 21'*
Tailplane Span	*27 ft 4.9 in*
Tailplane & Elevator Area (gross)	*171.1 sq ft*
Tailplane dihedral on Chord Plane	*10°*
Tailplane incidence:	
(Normal)	*plus 1°*
(Range)	*Maximum plus 1° 52'*
	Minimum minus 3° 52'
Gross Fin and Rudder Area	*71.22 ft*

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Who Pays?

(*Continued from page 13*)

ment is to prove, if he can, that the injured person himself was contributing to the cause of the accident by some negligent act of his own.

In addition to this liability of a pilot for the injurious results of his negligent operation, the owner of a rented or borrowed plane may also be in for a trouncing in court for the same negligent act that the pilot pulled off. This responsibility of the plane owner, however, is greatly qualified by conditions.

Within the range of present legal rules, the owner of a plane who either hires or loans it to another to operate for his (the pilot's own purposes) may be summoned to court and required to pay damages to the pilot if he survives an accident or to his heirs if he succumbs, only under these conditions: His liability will accrue if, at the time of renting or lending the plane, the owner *knew* of defects or lack of repairs of the machine, or was ignorant thereof by reason of his negligent failure to properly inspect the vehicle and have necessary repairs made. It must, of course, be a fact that the pilot himself was ignorant of any defect, and that the accident resulted directly from the defect or lack of repairs.

An instance highlighting these legal principles was threshed out in the Maryland courts. A young fellow holding a license, with 300 to 400 hours to his credit, rented a plane for an hour from a flying service company. The plane had two gasoline tanks, and a selector valve.

Just previously, the plane had been rented to another who had been up some 45 minutes, using gas from the left tank. When this pilot came down, the selector was on the left tank, then practically empty, the right being full to its capacity of 22½ gallons. He said to the pilot who was about to go up with a student pilot in the rented plane, "The gas tank is practically empty; switch it." The pilot answered, "Okay," and took the controls, the student getting into the back seat. Up about 900 feet, the motor "started to cut and miss." The pilot shouted to the student to work the wobble pump, which the latter began to do energetically and kept it up. However, the engine stopped completely, and the plane crashed, killing the pilot and injuring the student. The victim, while working the controls, had neglected—or forgotten—to switch to the full tank of gasoline.

A lawsuit against the flying service company in behalf of the widow and a child of the pilot followed, with a charge that the company had rented him a plane that was defective in some way, and that the defect had caused the crash. The claim was that the defective condition had caused the vehicle to use an abnormal amount of gas which was soon exhausted. But the court concluded that the accident was not caused by any remissness or neglect on the part of the flying service and it, therefore, was absolved of liability.

It is another important edict of the law that the owner of a rented or borrowed plane, who has not neglected to keep the machine in reasonably safe condition for operating, cannot be held responsible to third persons for the injurious results of accidents growing out of the pilot's negligence or incompetence, unless under the particular circumstances he was actually the agent or employee of the owner.

A Massachusetts case illustrates this. A flight instructor had his own plane in the air with a girl student. Another pilot, Finley by name, was aloft in the vicinity at the same time, flying an airplane he had rented from a service company. The devil or some other nefarious influence got into Finley and prompted him to pull off a few flying capers intended to interfere with the instructor and his student, and to cause them annoyance and confusion in the serious business in which they were engaged.

In his sordid performance, Finley dove toward the other plane with frightening approaches and threats of collision, which he kept up to such an extent that the girl student became terrorized. Finally, in her alarm at one of his approaches, she screamed, "Here he comes!" instantly seized the controls then in the instructor's hands, and froze to them until the instructor's plane went into a spin and crashed, causing death to the girl and injury to her instructor.

The company-owner of the plane rented to Finley was sued by the girl's parents and by the instructor, the owner of the other plane, for damages on the claim that it was responsible for his (Finley's) performance. But the court, while ruling against Finley himself, merely dismissed the charge against the service company with the meaningful remark: "There was no evidence whatever that Finley was operating the plane of the corporate defendant as its agent, or in its behalf, or otherwise than for his own benefit as the hirer of it."

In another illustrative instance, "B" was an ex-soldier learning to fly as a part of the veteran's training program. For his use in this program, the government hired a plane from a service company, and paid the tuition for the flight instruction.

One day "B" went to the airport and was accompanied by a friend whom he intended to take up. Since the government would not pay rent on the plane if a passenger were carried, "B" paid for it himself, and he and his friend took off. They flew over the town twice, and then to their own neighborhood, flying low so they could identify their own homes.

Suddenly, the engine went dead. The plane nosed down and crashed, plunging into a house. It caused death to the pilot and injury to his friend.

The friend sued the owner of the service operation that had rented the plane to the pilot. He wanted compensation for his injuries which he charged to have been oc

French Hurricane

Called *Ouragan* (*Hurricane*), this single-place interceptor-fighter is the first jet aircraft design to go into production in France. Slated for the French Air Force, it is powered by an Hispano-Suiza-built *Nene* of 6200 pounds static thrust. The *Ouragan* is of all-metal construction with a tricycle landing gear (nose wheel retracts forward and main wheels inward). The *Nene* is located at the rear of the fuselage. Armament consists of 20-mm cannon in the nose and rockets under the wings. Note the fuselage dive brakes in open position just behind insignia. The *Ouragan* has a wing span of 39.9 feet, is 35 feet long, has a gross weight of 12,320 pounds and an empty weight of 7,250 pounds. Top speed of this French jet is 600 mph, has 700-mile range, and an 8,000 fpm rate of climb.

casioned through some defect of the engine. When the friend was unable to prove his charge, the plane's owner was cleared of responsibility for the crash.

"W," a young flying enthusiast who was trying for his pilot's license, held a student's permit which allowed him to rent and fly a plane. Not having a pilot's license, he was not authorized to take a passenger on a flight. Nevertheless, he went to a flying service company and rented one of its planes for a three-day period, intending to fly to another city to attend a fraternity convention, taking along a brother-member for the function.

During the trip, something went wrong and the plane crashed. The pilot was killed, and his young companion gravely injured. The parents of the injured boy brought the flying service company into court seeking a judgment for damages against it because of his injuries. They claimed liability against it on these specific grounds: That "W," the student-pilot, was reckless, irresponsible operator of a plane; that the company knew he was of that character; and because of this knowledge it should have anticipated that he would have committed negligent acts such as caused the crash; and that the law, therefore, made the company liable for the dire results, which it could have prevented by refusing to rent the plane to him.

The court sided with the boy's parents in all of these charges except one—the litigants did not prove that the service company at the time of renting the plane knew that "W" was a reckless and negligent operator. "One who rents an airplane to a known reckless operator," was the gist of the court's ruling, "is liable for any damage which reasonably and proximately results from the reckless handling of the plane."

"But," the court continued, "there is no evidence that the service company could have reasonably anticipated that "W" would take the passenger up in the plane while he had it rented, in violation of the rules of the Civil Aeronautics Board, or that he would endanger his flying career by having his student's permit revoked while trying for his pilot's license." The court accordingly exonerated the service company from legal blame.

The foregoing specific cases which have been aired in the courts demonstrate how the legal rules of financial liability or of exemption from liability are applied to pilots as well as owners of planes when pilots operate rented planes, and damaging or injurious accidents occur during the operation. To re-state these rules in a sentence or two for emphasis, the principal ones are these: A pilot guilty of negligence while in control of a rented machine is liable for all property damage or destruction, and for personal injuries or death, caused proximately by his negligent operation. He is not liable in any case of unavoidable injury occurring without negligence on his part. The owner of the rented plane is liable to the pilot himself or to third persons only if the machine he rented to the pilot was known by the owner to be defective or out or repair, or the owner knew the pilot to be such a reckless operator that it could reasonably be anticipated that he would have an accident and injure someone.

Practically the same rules of law govern situations where a plane is not rented but loaned to the pilot, or gets into the pilot's possession and control for his own purposes and with the permission of the owner.

A man, for instance, owned a private plane and had an agreement with his brother-in-law for the latter to use it whenever he wished, provided it should always be flown by the owner's pilot. While being so flown on a trip when the brother-in-law's wife went along, there was a crash in which the wife was killed. The brother-in-law sued the owner and his pilot on the claim of negligence of the pilot in operating the plane. The court ruled that the pilot was the owner's employee, though flying under the direction of the brother-in-law, and that the owner, as employer, was responsible for the negligence of the pilot, if any, which resulted in the woman's death. But it was further ruled that no negligence on the part of the pilot had been proved, so that the ultimate judgment exonerated both the pilot and the plane's owner.

"A," as pilot, was operating "B's" plane solely for "A's" own purposes, but with "B's" express permission. "A" collided with another flyer, the collision being caused by "A's" negligence. The other flyer received injuries, and sued "B" as owner of the plane, for compensation. He could not prove that "A" was at the time in any manner acting as agent or employee of "B," and so he lost his case, the judge stating: "The owner of a vehicle cannot be held liable for the negligence of its operator unless it was being used at the time in the owner's business by the operator within the scope of his employment."

Take in final illustration of the pertinent rules of law where a borrowed plane has been used, a striking factual situation presented in an occurrence in Oklahoma.

An advertising man desired to go up to display from an airship certain electrically lighted letters, signs, or messages for night advertising. He arranged with an employee of a flying service company to go up with him after the employee's working hours, using one of the company's planes. The employee got permission of the owner to use this machine "for free."

The flight was completed as planned, with everything apparently all right, and a descent made. While approaching near to the hangar, a fire was discovered in the wings. Several extinguishers were rushed from the hangar and used until the fire was practically extinguished. Near the end of the rushing around with extinguishers, an elderly man who was night watchman on the premises ran out of the opening of the hangar door with one in his arms. He made directly for the front of the plane, ran straight into the spinning propeller, and received blows from it from which he died.

His heirs sought by a damage suit to collect pay for his death, claiming that the service company was liable for the acts of those persons in charge of the plane, one of whom was its employee. The decision went against the heirs, on the finding of fact that the only employee of the company participating was one who was engaged by the advertising man after hours, to whom the company had merely loaned the machine for the occasion.

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Navy Night Fighters

(*Continued from page 15*)

of dire necessity. The RAF used it first. Early in World War II, when England's handful of *Spitfires* and *Hurricanes* made the *Luftwaffe's* daylight blitz too costly, the Nazis turned to night raids. Still undaunted, the few men to whom "so many owed so much" radar-rigged a few Boulton-Paul *Defiants* and went aloft after them. The net result was quick development of effective night-fighter defensive tactics and a sharp drop in the number of Nazi night-bombing missions over Britain.

But night fighting at that time was effective mostly because of its newness and the daring of the desperate British pilots. The radar rigging used in the *Defiants* was crude and of very short range. Initial contact with the Nazi night-raiders had to be made by radar stations on the ground. The results of this contact were passed up by radio to the night-cruising British airmen, guiding them to the general vicinity of the oncoming bombers. The pilots had to be very close before they could detect the enemy airplanes on their own radar screens. This left a minimum of time during which to make necessary calculations, adjustments, and go in for the kill.

However, the surprise element compensated to a large extent for the shortcomings in equipment. Goering's supermen just couldn't get used to machine guns blooming suddenly in the black and seemingly empty night sky. They didn't like that vomiting lead that came from nowhere and took them apart as effectively as though it had been broad daylight. And so night fighting was born.

The American forces bumped into their first major night operational problem on Guadalcanal. Lockheed P-38's and Douglas A-20's, guided by searchlights, tried to put a knock-out drop in "Washing Machine Charlie's" nightly sprees, but were not successful in the attempt. The Navy, at that time, had no satisfactory equipment available for night fighting, but thanks to "W. M. Charlie's" persistence, the Navy decided to do something about it. The net result was a commissioned night-fighter experimental and development group, established at NAS Quonset Point in 1942.

Known as *Project Affirm*, this unit carried on all phases of development and experimental work and served as both source and clearing house for all information concerning night-fighting equipment, doctrine and tactics. The man in charge of this unit had been a member of the famed RAF American Eagle squadron during the London blitz. He knew what night-fighters could do. *Project Affirm* set out immediately to fit the best available electronic equipment into the best available Naval aircraft on hand.

The necessary radar equipment was obtained from the Massachusetts Institute of Technology's radiation laboratory. Thirty original Chance-Vought F4U-1's were delivered to the Naval Aircraft Factory, where the radar equipment was installed by Naval personnel. During this same period, Grumman Aircraft began production of the F6F night-fighters. Both the converted F4U's and the F6F's were ready for use at about the same time.

The next problem was to obtain personnel for this new branch of Navy air. Pilots with night-flying experience were few and far between. None were available with actual night-combat experience. The prospect of flying swift and sensitive fighter airplanes off and onto carriers during darkness and in bad weather was not pleasant. The outcome of the entire night-fighting program was in doubt. As often happens when the picture is blackest, the Navy called for volunteers. That was enough. So many pilots offered their services that a choosy selection was possible.

Night pilot flight training was started at once. Long hours on instruments were practiced until the men could handle the planes practically blindfolded. This was followed by intensive training in night interception work. The planes took off regardless of the weather, under bright stars or into heavy overcast, and guided by GCI (Ground-Controlled Intercept) radar, sought out the general location of "Bogey" (the target airplane), picked him up on their cockpit radar screens, then flashed in for the "kill."

In April, 1943, the Navy's first VF (N) squadron was formed at *Project Affirm* with 18 pilots, six ground officers, and 30 enlisted men. Four months later, in August, 1943, half of this squadron went to the South Pacific. One team under LCdr. "Pete" Aurand flew the F6F night-fighters; the other team, under Cdr. "Chick" Harmer, flew the converted F4U's. Shore-based in the Solomons, the first night-operational duty was washing out "Washing Machine Charlie." Charlie was soon "washed."

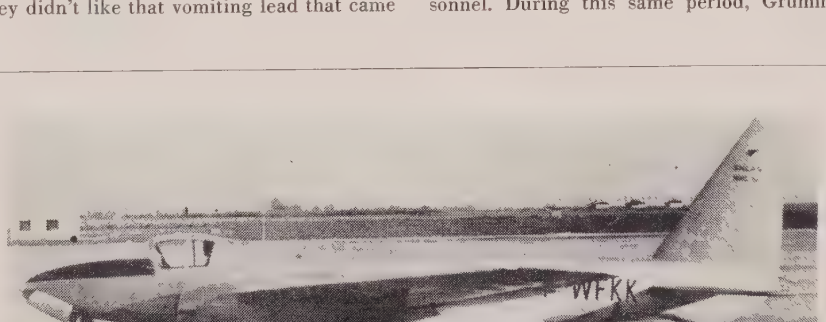
Night-fighters went aboard carriers for the first time in January, 1944. Two squadrons, one still flying the *Corsairs*, the other the *Hellcats*, manned four CV's. Though squadron identity was maintained, these first ship-based night-fighters actually were broken into six-pilot units. The first duty was completion of 12 nights of continuous and intensive night-fighter practice off the carrier decks. Then they were ready for action.

At first the work was mostly defensive. The first night interception came early in 1944 when the leader of VF (N) 101, flying a *Corsair*, splashed a Jap *Betty* near Truk. On succeeding nights, three more Jap night intruders were shot down. One of them fell in flames over a U. S. task force, and from his place on the bridge of the flagship, the admiral radioed, "Well done!"

With increasing experience, and with fewer Jap intruders to contend with, the night-flying pilots gradually turned to offensive action. Intruder, zipper, and heckler missions against enemy shore bases and fleet units were begun. The heckled became the heckler. The cover of night offered no haven to the retreating Japs. A lot of night-flying kamikaze missions were effectively smashed long before they reached their target.

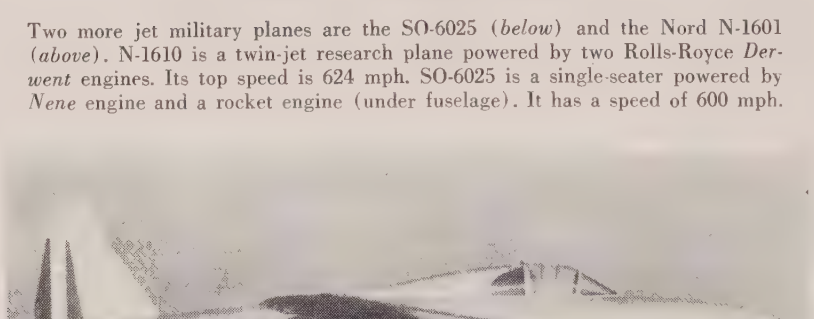
Final proof of how effective the night-fighters became is couched in a statement by Admiral J. S. McCain who said that during the entire time that Task Force 38 operated off Japan, not a single night attack was made against the ships—all due to the presence of effective night-fighter cover.

Success of the night-fighters based on regular carriers led naturally to the idea for a night-carrier particularly suited to supple-



Other French Jets

Two more jet military planes are the SO-6025 (*below*) and the Nord N-1601 (*above*). N-1610 is a twin-jet research plane powered by two Rolls-Royce *Derwent* engines. Its top speed is 624 mph. SO-6025 is a single-seater powered by *Nene* engine and a rocket engine (under fuselage). It has a speed of 600 mph.



the night-fighter operations. In the sum-
of 1944, a group of well-trained VF
and VT (N)'s were assigned to the
Independence which became the first
nated night-carrier in fleet history. Con-
d success of the *Independence* with its
-flying pilots during the remainder of
war established the soundness of this

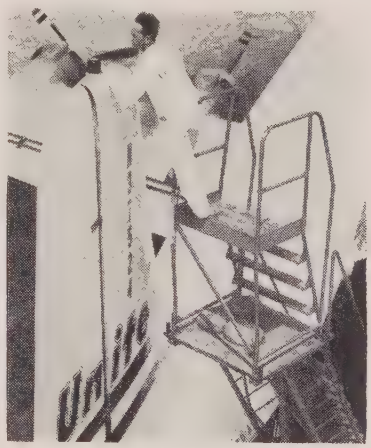
om the very beginning, the night-fighter
had a tough go of it. The experience
red and the unknown risks they had to
went beyond the status of ordinary
ght operations. The night-fighter pilot
o be able to do everything a daylight
could do, plus being an expert instru-
man, able to interpret and follow GCI
tions up to the point of contact, then
pret the "pips" on the cockpit radar
n in a manner to make his attack ef-
e. All this in conjunction with the psy-
gical factor of not being able to "see"
e he was going, what he was shooting
or his way home.

time, the strain of so many responsibili-
ecame too great. Efficiency dropped off.
e was only one obvious answer—a dual-
airplane carrying a specialized radar
to aid and relieve the pilot of some re-
ibility. Grumman started work immedi-
on its two-place F7F, but this airplane
ot reach the fleet in time to see action
g World War II.

th the coming of peace and demobiliz-
night-fighter training and personnel
red along with all branches of the serv-
For a time, the program was almost in-
e. Only two squadrons were retained as
—one on the East Coast and another in
ii. These were the Night Development
drons which later became Night Com-
e Squadrons. Instigation of the Navy
eather program finally revitalized this
of Navy Air. The two composite squad-
were reorganized into the Fleet All-
her Training Unit Pacific at Barber's
T. H., and the Fleet All-Weather
ing Unit Atlantic at Key West, Fla.,
two night composite squadrons, VC-3
VC-4, each manned by qualified all-
ier pilots.

e Fleet All-Weather Training Units are
ctive and going strong as organized, but
night composite squadrons underwent
er change before reaching their present
Both squadrons were split into night-
r and night-attack squadrons, making
squadrons in all. The night-fighter
drons are VC-3 at Moffett Field near San
isco, and VC-4 at Atlantic City. The
-attack squadrons are VC-33 at Quonset
, and VC-35 at San Diego. These are,
ally, training squadrons charged with
ding the fleet with good all-weather
.

e airplanes used by these squadrons
been changed from time to time since
d War II—always in search of "some-
better" for night-fighting use. Chance-
ht delivered the first F4U-5N's in 1948;
adaptations of the Douglas AD *Sky-*
r were delivered about the same time.
irst jets used were McDonnell F2H-2N's
conversion of the day-fighting F2H-1.
hese different airplanes each contained
mmon shortcoming insofar as night-
ng was concerned. All had been de-
d, developed and built as airplanes first,
radar rigging and installation a sec-
y consideration.



TAIL LIGHT that revolves, offers better distinguishability is tested by UAL

But the Navy was not too much worried about this situation. They had another "rabbit in the hat." This "rabbit" was conceived in 1945, and was being fostered and brought to maturity by a fellow named Edward H. Heinemann, who is the world's top designer of fighter and attack airplanes for the U. S. Navy. Among Heinemann's design credits are the A-20 and A-26, the SBD, the AD in some 22 versions, the A2D turbo-prop attack airplane, the new bat-wing supersonic F4D, the now-famous *Skystreak* research airplane, and the supersonic *Skyrocket*. Backing Heinemann's efforts to produce a new night-fighter were his crack design team and the entire facilities and personnel of the El Segundo Division of Douglas Aircraft Company, now in its twentieth year of design and construction for the Navy.

The first F3D's were delivered to Night Composite Squadron VC-3 at Moffett Field in December, 1950. The Navy boys wasted only a few seconds in gasping admiration, then climbed into the cockpit and took off. This was it at long last! This was a night-fighter designed to be a night-fighter and built around all the things that make a night-fighter tick! This was *the* airplane!

Back in 1945, the Navy had handed the El Segundo plant a half-ton of radar equipment (on paper) and said in effect . . . "Build us an airplane around it. Build the airplane wide enough so the pilot and radar operator can sit side-by-side. Make it fast. Make it slow. Build it so it can climb rapidly, or come down like an express elevator with a broken lift cable. We know it is impossible, but do it anyway."

The *Skyknight's* top speed is well into the 600-mph bracket; it stalls at less than 100 mph. It can drift just above the terrain at 150 mph, thus making it an ideal ground-support airplane if and when it is necessary to use it as such. It can stand on its tail and go above 40,00 feet quickly enough to intercept any so-called "super bomber," then call for landing instructions from that altitude and be ready to land when the control tower gives the word. According to Cdr. "Chick" Harmer of Composite Squadron VC-3, its chances of making a "kill" during the darkest night are in the vicinity of 100 per cent.

The pilot and radar operator are seated side-by-side where they can conveniently discuss last night's date or the enemy, as the situation dictates. No garbled inter-cockpit communications are necessary. One can take over the job of the other for momentary relief. The arrangement provides for 100 per cent teamwork. The cockpit is cooled and pressurized and comfortable, except that a local snowstorm occurs if the pilot should turn the temperature control to full cold when the humidity is high.

The F3D weighs around 22,000 pounds—a little less than a DC-3. Its 50-foot wings (approximate measurement) fold upward to reduce shipboard storage space. Auxiliary fuel tanks can be hung just below the folding hinge on each wing, or the tanks can be replaced by various external armament. With full auxiliary tanks, the night-fighter could cross the nation non-stop. Two 2,000-pound bombs can be carried instead of the extra fuel. The external fuel tanks, by the way, are of the new streamlined design which reduces drag and adds many knots to the airplane's top speed.

Two Westinghouse J-34 jet engines, delivering over 3,000 pounds of static thrust each, are mounted on opposite lower sides of the fuselage. An engine can be changed in an hour if necessary. One engine will keep the *Skyknight* in the air. Body-type dive brakes are mounted in the semi-monocoque fuselage. These air brakes reduce the F3D's speed so fast that the airspeed indicator blurs as it races toward zero. A stall-warning indicator keeps the *Skyknight* pilot from going too slow.

Not much can be said about the radar installation except that it weighs well over a half-ton and has a much longer effective range and a wider angular range than any radar hitherto used in any aircraft. This makes it possible for the crew to follow the target on their own radar screen over a much wider area. There is less dependency on GCI (Ground Control Intercept).

Ed Heinemann had to think for a moment when asked for a direct quote on the most outstanding feature of this new phenomenon. He finally offered this advice: "It was a tough design problem but we think it has proved that the Navy Bureau of Aeronautics knows what it wants. The extra degree of design discipline applied to carrier-based airplanes results in a machine that can operate from the smallest landing fields and has unusually good low-speed stability and control."

He did not mention the nose wheel and "soft" landing gear which minimize the possibility of damage during carrier landings, nor the hydraulically boosted controls which make finger-tip flying possible. He didn't say anything about the crew-escape chute back of the seat, down which the pilot and radar operator can slip like a piece of laundry and out into the clear air well away from jet blast and tail structure. Design and installation of this escape chute was based on extensive aero-medical studies by the Navy's aero-medical group.

Commander "Chick" Harmer was a bit more effusive in his expression of opinion regarding the F3D *Skyknight*. "I love the airplane," he said. "Douglas did a wonderful job."

Then, being a man of action, "Chick" climbed into an F3D and drifted down the coast from San Francisco to Los Angeles—over 400 miles in 39 minutes flat!

MARINE CREWMEN assemble a 'copter on an airfield in Korea while ground crews on the right ready two AF fighters for air sortie

'Copters in Combat

(*Continued from page 19*)

and in the air, have adapted another machine to their particular kind of warfare.

The bottoms of Marine Corps landing craft had hardly dried from World War II before Marine leaders were casting appraising eyes on possible future amphibious weapons and equipment. The Corps had been designated by Congress as the service to perfect amphibious warfare, and Marine officers knew that there could be no letup in their quest for adequate implements to carry out their mission.

Seeing the helicopter, Marines visualized it as a machine which could be used effectively in the Leatherneck's fast and hard-hitting type of warfare. Accordingly, they began experiments to evaluate the helicopter and its potentialities for combat service with the Marine Corps.

On December 1, 1947, the first helicopters arrived at the Marine Corps Air Station, Quantico, Virginia. These were two H03S-1 Sikorsky helicopters, the nucleus of the squadron later designated HMX-1. One year later the Marines had five Sikorsky-type ships, five HRP Piasecki-type ships and one HTL-2 Bell helicopter.

Most of the 'copter experiments were concerned with adapting the "flying eggbeaters" to use with ground forces. Tasks such as artillery spotting, evacuation of wounded, supplying ammunition, landing troops, rescuing aircraft crewmen at sea, and numerous other jobs were all in a day's work for the new Marine Corps squadron.

Early in these tests difficulties showed up involving the standard accessories of the helicopter. These accessories were found unsuitable for Marine uses and so the boys had to devise their own "extra" gear. One such device was the self-unloading hook invented by Capt. R. A. Streiby and Lieut. Roy L. Anderson. This hook enables the hovering helicopter to lower its cargo on a cable and, as soon as the cargo touches the ground, the curved jaws of the hook are automatically released. This not only eliminates the necessity of having a man on the spot to disengage the cargo manually but saves the pilot from hovering too long and becoming an easy-to-knock-down sitting duck for enemy gunners lurking in the vicinity.

The Piasecki HRP-1, with a load capacity of about one ton, proved to be ideally suited for special Marine Corps missions. In supply missions this helicopter can carry a 37-mm anti-tank gun, a 75-mm pack howitzer, ammunition, food, personnel or any other comparable item, and deliver it directly to the point where it's needed.

In addition to simulated land operations with the 'copter, Marine Corps personnel conducted experiments off carriers. Much valuable experience in ship-board operations under simulated combat conditions was derived from this tour of training, and it became apparent that, if need be, a Marine assault team could be lifted from the deck of a carrier and transported inland to its objective by 'copter. This would eliminate normally heavy beach casualties and allow supporting ships further dispersion in case of aerial attack.

A Sikorsky H03S-1 and a Bell HTL-2 were sent to Camp Lejeune, N. C., to work with the infantry and tanks of the Second Marine Division, and later the helicopters were used by the division during Atlantic Fleet Maneuvers. When Marines went to Newfoundland for cold-weather training, they took along helicopters for evaluation in frigid climates. The more the Marines saw of the helicopters the better they liked them.

When the conflict began in Korea and Marines were ordered overseas, they took along their helicopters. That they have proved their value in Korea is a known fact to all. Lieut. Lemuel C. Shepherd, Jr., Commanding General of the Pacific Fleet Marine Force, declared that "Marine Corps helicopters in Korea have added a new chapter to the history of military science." After completing an inspection of the Far East fighting front, General Shepherd asserted that the value of helicopters as a military weapon had been established beyond dispute.

Marine airmen in Korea use helicopters for liaison, reconnaissance, artillery spotting, flank security, movement of patrols and security detachments, food delivery to front lines, evacuation of wounded and, on one occasion, used it to rescue a Marine pilot from the sea.

General Shepherd believes that if more helicopters had been available for service in Korea, their missions and tasks would have been unlimited.

Red Air Invasion?

(*Continued from page 23*)

ber had swollen to upwards of 40,000 men organized on a corps level.

This vast paratroop army was destined never to be employed as such. As the German armored thrusts sliced into Soviet territory during the Summer of 1941, the airborne regiments were thrown into battle piecemeal to blunt the rapier thrusts of Hitler's *Panzers*. In 1942, Stalingrad became the graveyard of the paratroop formations that had been built up during the winter to replace the original corps and, thereafter, Soviet airborne forces were used almost entirely as shock troops in ground campaigns.

During the great Russian advances late in the War, opportunities may have presented themselves for the employment of airborne elements, but the lack of transport airplanes was a decisive factor against such air assaults. One or two minor airborne operations were tried with indifferent success, but fuller use of transports and gliders was made to drop supplies and command personnel to partisans operating behind enemy lines.

As with turbojet development, radar and many other branches of military science, airborne techniques employed by the Western allies were watched closely by the Russians and the lessons proffered by our experience were fully digested. Much information was given to Russian military missions in England and the United States as to the preparations, execution and results of our airborne landings. Undoubtedly, the size of our airborne effort caused the Reds to think again along the lines they had "pioneered" before the War.

In addition to the incentive provided the Russians by our lead in this form of attack, circumstances improved after the war for the preparation of Soviet airborne armies. Transport and towing aircraft which (due to the exigencies of the moment) had been required to fulfill duties other than troop-carrying during the war, became available in ever increasing quantities as more and more production lines were switched to their manufacture. During the past few years large numbers of the sturdy IL-12 twin-engined transport have been supplied to Soviet Air Force transport units to replace the Li-2 (Soviet-built DC-3) and the lend-lease Dougla

47's of World War II vintage.

An indication of the actual numbers of -12's produced is given by the fact that State airline AEROFLOT is itself oper- ng between two and three hundred IL-12's, en though, in Russia, all needs are subor- nated to those of the armed forces. We can, erefore, suppose that since the War the ds have built up a fleet of military trans- rts at least adequate to their present train- ; and operational needs. This hypothesis is t credence by the continual reports out of ssia of the construction of a vast air trans- rt fleet which functions separately to the litary transport elements of the regional mmands.

The Ilyushin IL-12 and the Li-2 (DC-3) the most widely used military transport planes at the present time. In airliner m, the IL-12 carries a maximum of 32 ssengers, but the military version carries to 40 fully equipped paratroops. Two ver- ns have been built: the "A" and the "B." e "B" is a generally improved model with eater fin area, more comprehensive radio uipment and cleaned-up undercarriage and gine cowlings. The Soviet Air Force has ken delivery of many hundreds of IL-12A's d B's, but most of the IL-12A's have now en brought up to "B" standard. Evidence at production of this transport is more an ample to meet Soviet needs is given by ent attempts to export the IL-12 to South erica! After all, a country only exports a mmodity of which it has a natural super- ity! !

The IL-12B is powered by two 1,850-hp h-82-FNV radials which afford a maximum ed of 252 mph at 8,250 feet, an economical ising speed of 205 mph and a range of 50 miles. Spanning 104 feet, with a length 69 feet 11 inches, the IL-12B has a pay- d of 13,550 pounds and a gross weight of 000 pounds.

There is as yet no concrete evidence of the by the Soviet Air Force of such larger r-engine transports as the Ilyushin IL-18 d Tupolev Tu-70, although it is probable at larger transports are entering service. th the Ilyushin IL-18 and Tupolev Tu-70 admirably suited to Soviet Air Force uirements, being rugged transports with g ranges, capable of carrying around 100 ly equipped troops, and towing trains of ee heavy gliders.

The Ilyushin IL-18 is believed to have been ced in service by AEROFLOT on its Mos- v-Vladivostok route. Basically, a scaled- version of the earlier IL-12, powered by r 1700-hp ASh-82-112 radials, it has a ximum speed of 304 mph, a cruising speed 282 mph and a normal range of 1,864 les. Wing span is 127 feet 3 inches and gth is 100 feet 1 inch. The Tupolev Tu-70 comparable to the IL-18 in size and is a nsport version of the Tu-4 strategic bomber ich, in turn, was a copy of the B-29 *Super- tress.* The Tu-70 has an entirely new fuse- e, the length of which is 120 feet as com- red with the 99-foot fuselage of the Tu-4, it retains the wings, empennage, en- es, and undercarriage of the bomber. ny unconfirmed reports have indicated t this airplane is now in mass production the Soviet Air Force. Spanning 141 feet nches, it is powered by four 2100-hp ASh- radials which give it a maximum speed of proximately 315 mph, and a cruising range about 2,500 miles.

(*Continued on page 47*)

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Cross-Country Flight

(*Continued from page 21*)

purposes, it looks nice to see a high cruising-speed figure. To roughly figure the best cruise speed, you put the ship into level flight, throttle wide open, a normal load and—this is very important—no change of altitude. That will give you the plane's top speed. Then simply use a speed 20 per cent slower as cruising. Engineers may wince at this, but so far I've found that it works."

The return trip was much more restful, thanks to the steady unchanging altitude, airspeed and heading. Until this demonstration, it had never occurred to me that I had been fighting the airplane a bit and "flying" it constantly! Actually, when trimmed exactly, the plane was stable enough to practically go home by itself.

"Why are we doing this, Russ?" I asked, pointing to a dog-leg in our course that was taking us about seven miles off a direct-course line. "Wouldn't the direct route save time?"

"Well," he explained, "I would like to stay at this altitude to get the best winds. In going slightly to the right I can cut through a gap in this line of 3200-foot ridges. The reason I would prefer not to go across so low is that the country in there is very rugged and deserted."

"I thought engines were now almost infallible."

"They are . . . I guess this is just a habit of caution. I like to avoid bad country when it doesn't take over two or three minutes. If it takes too long to go around a bad stretch, I'd go direct, though a bit higher. Actually the real reason is to remove worry from the trip."

I agreed. "It is less tiring to have good country for forced landing beneath you."

Instead of fretting over navigating each small checkpoint, Russ used the radio to cross-check two LF radio ranges.

"Omni would be a nice addition for this ship. . . . It sure does take the aggravation out of navigation," he said.

Russ did not seem to worry much with his navigation. He flew relaxed, without wondering about his pinpoint position. Instead, he relied on elapsed time, prominent landmarks and radio position fixes. As he told me, the only time he kept a mile-by-mile check of his position was when the weather conditions were uncertain and it was necessary to know the quickest route to an alternate airport.

He seemed to navigate effortlessly, with his approximate position in mind all the time. Though we did not need them, Russ always picked large unmistakable brackets to hold us within a certain area. Every airport came up over the nose right on schedule.

The radio played a prominent part. It was especially useful when we decided to stay "on top" of the strato cumulous forming ahead of us. "Never do this without a good radio," he cautioned. "Though the forecast may be for clear skies at your destination, the weather forecasters aren't psychic. There is always a chance of conditions which are impossible for them to foresee. So, unless you are equipped with radio and can locate a clear station within range, it is very possible to fly along without suitable warning that your destination is closing over."

"Then you're caught on top?"

"That's right," he replied. "And without radio, over-the-top navigation is pure dead reckoning."

On our way home we obtained weather reports and were able to determine our position regularly. There was no strain for us because we were able to positively determine CAVU weather conditions at our destination.

"If you wanted to be really fancy," Russ suggested, "you could study up on pressure-pattern flying."

"Is that technique complicated?" I asked.

"It can be. For the lightplane it boils down to spotting the high- and low-pressure areas when you get your weather briefing. Then, when possible, you take advantage of the winds resulting from these high- or low-pressure areas."

"That's easy," I commented, "for even I could remember that in a 'high' the circulation is clockwise, away from the center of the high, and in a low-pressure area the circulation is counter-clockwise toward the center of the low."

"I wouldn't go to a lot of trouble to catch these winds though," he advised. "Sometimes you lose more time climbing or dog-legging the course than you will gain with the favorable winds. The scheduled airlines found that this was especially true on their short hops."

We made stops at two airports to meet the managers of two branch plants. The last stop took a lot longer than I had anticipated, so after take-off I told Russ regretfully that we'd have to skip the next stop entirely if we wanted to get home before darkness set in.

After a few minutes of figuring weather forecasts, Russ told me that the stop would be possible. "Conditions should be ideal tonight," he said. "We won't be coming in too late and there are very good night-flying facilities along our route."

"It would pay you to get checked out at night," he told me. "Not that you should fly bad weather or stick your neck out all the time . . . but occasionally it comes in very handy. It adds hours to your day and takes the strain out of trying to beat th sun."

After leaving the last branch plant, w took off and flew in fading sunlight. Abou halfway home darkness caught up with us but we continued steadily on down th lighted airway toward home. It was th smoothest, most pleasant part of the trip, an it sold me on night flying.

"The most important thing at night," sai Russ, "is not to get involved in any situatio you can't handle. Keep the weather in min all the time and avoid extended night flight until you get the equipment and trainin to handle instrument conditions, should the occur. For short hops, especially near larg cities, night flying can be almost identica with day flying. When between towns, firs make sure you have a clear horizon to pre vent getting entangled with instrument con ditions."

"In other words," I said, "when you begi to worry, it's time to stop."

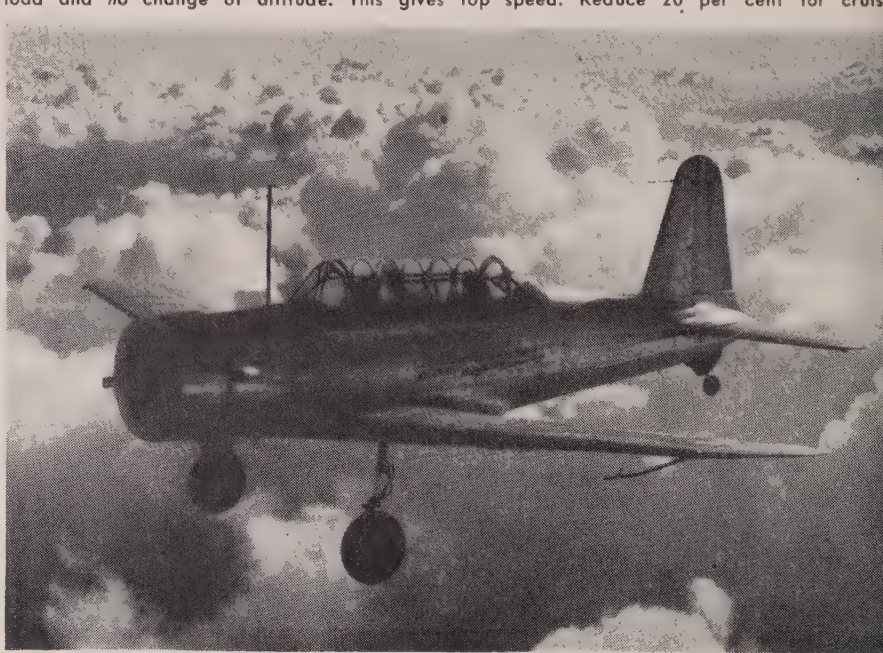
"Stop a little before that," he advised "After all, there's no need to worry yoursel on these hops . . . it's just not that impor tant. If the flight can be made easily an without risk, take off. Otherwise, it's foolish to gamble a few hours against the rest o your life."

Thanks to Russ, I have saved a lot of tim in the last year. Acting on his advice, checked out at night. Though I do not "stic my neck out," I have had many occasion to fly in after dark, and there's been n strain with it.

By using these methods of cross-countr flying, many of my associates have been sol on the use of the company plane. Before they had been unfavorably impressed wit the amount of time that apparently had to b spent in preparing for the flight and i making it.

With experience, all these pointers becom obvious. I was fortunate, however, in hav ing these cross-country tips pointed out t me in the initial stage of learning to us my plane. It has resulted in making my ne ship a real day-stretcher and a useful an profitable business tool.

CRUISE—To figure best cruise speed, put plane in level flight, throttle wide open, norma load and *no* change of altitude. This gives top speed. Reduce 20 per cent for cruis



Red Air Invasion?

(*Continued from page 45*)

One of the smaller and lesser known of oviet transport airplanes, used by both the oviet Air Force and the Polish Air Force r paratroop training and ambulance work, the Shcherbakov Shche-2, a high-wing utily machine of rather archaic appearance, owered by two 145-hp M-11-FEA radials. f simple construction and lacking many of ie refinements considered essential in Westrn airplanes, the Shche-2 can carry eight ully equipped troops or nine stretcher cases. Iaximum speed is 98 mph and the Shche-2 ruises at 83 mph.

Little is known about the actual dropping echniques employed, but the Russians cerainly have intimate knowledge of all our lanning and operational procedures develped up to the end of the War. On the evience of display drops at the Air Parades, ie airplanes now available to them, and the rge paratroop formations known to have een trained during the past five years, the ussians could certainly mount a very large irborne operation at any moment. This fact gether with the present inadequacy of Westrn Europe's defenses might be of crucial nportance should open conflict break out ithin the next two or three years.

Apart from the new fleet of transport airlanes built since the end of the War, inreased emphasis is now placed on the reforcement and supply of paratroops by large argo and troop-carrying gliders. Russian liders for similar duties were in existence 1934, and it is well known that Oleg K. ntonov's A-7 glider was used in small numers for aerial supply during World War II. ince that time the large cargo glider has ome to assume some importance in Russian vil and military aviation, partly as an airne "aerial freight car" but primarily for ie support of airborne operations.

Illustrated here are two standard assault liders of the Soviet Air Force. Exact desigations are hard to confirm, but it is believed at they are respectively the KTs-20 (degned by Kolesnikov and Tsibin) and the ntonov Ant-11 (although some reports sugest that the latter airplane was designed by lex Yakovlev).

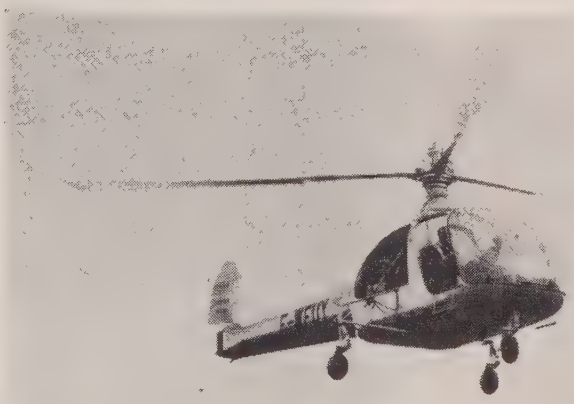
The KTs-20 appeared late in 1944 and was xperimentally tested on airline routes beween Moscow, Novosibirsk, Gorkii and Kuishev. At the time, it was officially anounced that these tests were intended to stablish data on take-off characteristics of irplane-glider combinations and to ascertain ie best type of connection between glider nd tug, but it can be assumed that the rials provided the Soviet Air Force with uch valuable information on the capabilities f this type of airplane. The KTs-20 is of ll-wood construction, spans about 78 feet nd has a length of some 52 feet. A flight ompartment seating a crew of two in tanem is positioned in the upper portion of ie forward fuselage, and between 24 and 30 ully equipped troops can be carried. Maxium towing speed is around 145 mph.

Antonov's Ant-11 is a larger aircraft bearg a strong resemblance to Britain's warme *Hamilcar* glider. This glider has freuently been seen towed by the IL-12, and ie box-like, capacious hold of the Ant-11 arries from 30 to 35 fully equipped troops. here appears to be a retractable ramp at the rear of the cargo hold to facilitate the stowage of bulky items of equipment. The Ant-11 has a loaded weight of around 25,000 pounds and can be towed at 170 mph.

Best evidence of the Soviet's interest in airborne troops is that given by the rapid expansion of civilian parachuting under the auspices of the DOSAV (Society of Voluntary Assistance to Aviation). Parachuting is now virtually a national sport, not only in Russia but in the satellite states of Poland, Czechoslovakia, Rumania and Hungary. The satellite states also have airborne elements as component parts of their armed forces. It is of interest to note that Czech paratroops, in particular, are modeled on the British pattern and that many were actually trained in Britain during the War. The same is true to a lesser extent of Polish airborne units, although greater Russian influence is shown and their entire army is now being modeled along Russian lines.

Sponsor of the parachute movement in Soviet Russia is, as has already been mentioned, the DOSAV organization, which also organized the vast civil air-training program in all aspects of theoretical and practical flight training, including modeling, gliding, powered elementary flying and, of course, *parachuting*. In actual fact, the "voluntary subscriptions" to DOSAV are a compulsory levy on every single wage-earning Russian, but the result is that training up to elementary flight standard is available to all healthy young Russians, male *or female*. The DOSAV-trained elements form a vast and easily tapped pool of reserves for the airborne armies. Personnel of the airborne units are looked upon as the élite of the Red Army and only the best of the annual intake of recruits are accepted.

It is possible that the Russians are behind us in ironing out the bugs in airborne-supply technique. British and American techniques were formulated under wartime conditions and were proved in the hard school of war. The Reds have yet to give their airborne elements an operational shake-down. Nevertheless, there is no doubt that Russia *has* airborne formations of considerable size and they have a place in any aggressive plans that the Reds are making. ✣



French Turbine 'Copter

The SO-1120, a development of the SO-1100 and SO-1110 helicopters, is one of the first turbine-equipped 'copters to have flown. The rotor is driven by combustion chambers placed at the blade tips and fed by a moto-compressor unit located in the fuselage. This unit consists of a 270-hp turbine which drives the feed of the rotor compressor directly. SO-1120's top speed is 112 mph, cruises at 84 mph.

Guided Missile

(*Continued from page 25*)

sedate Boston suburb and later at Roswell, New Mexico, introduced liquid oxygen as a practical oxidizer for high-impulse powerplants. Max Valiers, Hermann Oberth and the other experimenters of the 20's and 30's viewed the missile as a means for getting from the earth to Mars, rather than as a vehicle for human destruction.

However, the advent of World War II altered that dream. The first appearance of the Hs 293 air-to-surface power-guided missile in the Mediterranean indicated the start of a new era in remote-controlled weapons. While there were other missiles before this one appeared, still the Hs 293 (originally a glide bomb with power added later) was the first to follow command and be used with tactical effectiveness.

The appearance of the V-1 and V-2 missiles, and their possible effect on the course of World War II had they been produced in time and in sufficient numbers, is too well known to require further comment at this time.

The possible functions for guided missiles are best presented by examining the system of designation approved by the RDB's Committee on Guided Missiles. In the basic designation system, three letters are usually used: M for Missile, A for Air, S for Surface and U for Underwater. The common examples are as follows:

AAM: Air-to-Air Missile
ASM: Air-to-Surface Missile
AUM: Air-to-Underwater Missile
SAM: Surface-to-Air Missile
SSM: Surface-to-Surface Missile
SUM: Surface-to-Underwater Missile
UAM: Underwater-to-Air Missile
USM: Underwater-to-Surface Missile

While the SUM and USM missiles are strictly marine vehicles in the class of a controllable torpedo, the remainder are of direct concern to this study. With the exception of the entirely feasible UAM, all of the directions of study are either under active study or in development or production.

By their essential nature, all military missiles have things in common: 1) a warhead to give it purpose, 2) aerodynamic surfaces to give it control, and 3) systems for receiving intelligence and for exerting the interpretation of this information onto the trajectory or flight path of the missile. With the exception of glide bombs, now considered largely obsolete, all missiles have powerplants. In many cases, they have booster systems which are designed to furnish the additional thrust required to overcome inertia and get the missile clear of the launching site (*See Bumper photo, page 57*)

A typical guided missile's integral parts are analyzed in the chart on page 56.

The power furnished to a guided missile is relatively simple. Simplified turbojets, ramjets and pulse-jets have been considered and are adequate for many purposes at relatively low altitudes. However, they are still aspiring engines and, therefore, are only useful where they can take on oxygen from the atmosphere. The top limit for "breathing" engines under the best conditions is about 70,000 feet, which eliminates them for many missile functions.

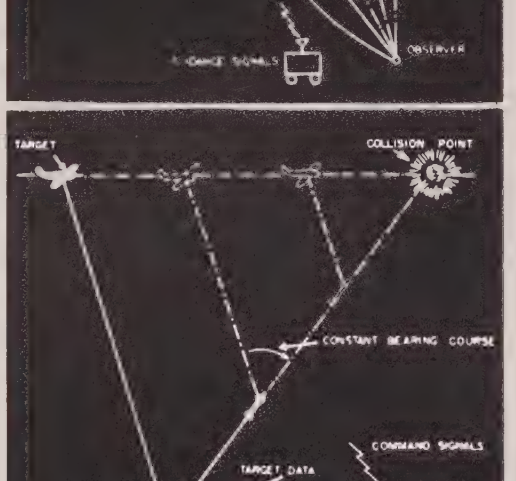
Powerplants that carry their own oxygen supply aboard are desirable for many functions. While there are several designs available, most rocket engines at present use a bi-fuel system, burning hydrocarbons like gasoline, alcohol or hydrazine hydrate and a concentrated oxidizer like liquid oxygen, red-fuming nitric acid or high-concentrate hydrogen peroxide. Other combinations like analine and nitric acid have also been studied. Solid fuels—usually an oil-and-oxidizer combination in a combustable asphalt base—are also in wide use, though chiefly in RATO (Rocket Assist Take-Off) units and as powerplants for launchers.

Our choice of possible rocket engines, their advantages and limitations can be studied in the accompanying table (*page 56*). The rocket engineer's task is to make the best selection for the particular task involved.

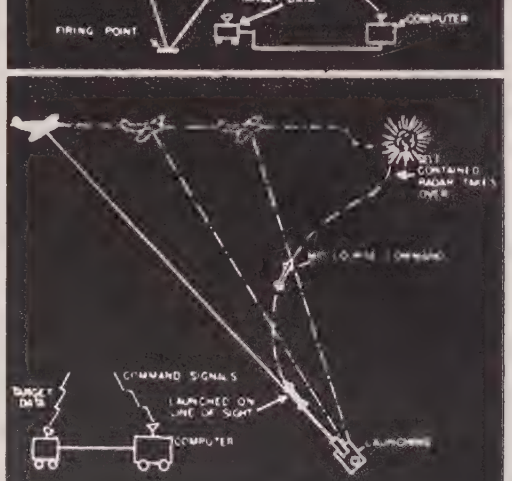
To this roster, two new types or rather modifications of existing powerplants will be added soon. These are the atomic ramjet and the atomic rocket. These probably will be quite similar to conventional powerplants in these classes, with the exception of the heat source which will be a nuclear reactor instead of a chemical furnace. In the case of the nuclear rocket engine, a working fluid will have to be provided to act as a medium of transmission. A leading nuclear engine expert suggests the use of liquid hydrogen, pumped out of a tank and through the reactor where it is vaporized and heated

Classes of Missile Guidance

BEAM RIDER GUIDANCE—The beam rider Surface-to-Air missile (SAM) "climbs" the radar beam that tracks target. The electronics of the missile keep it centered in the beam. Interception is inevitable as long as the radarman keeps beam on the target



COMMAND GUIDANCE—Ground observer, tracking approaching plane on the radarscope, launches missile. Control commands are transmitted to missile over FM radio channels. Radar readings on foe and missile are computed, collision-course plotted



HOMING GUIDANCE—In this, combination guidance is used (either Beam Riding or Command) to get the missile to the target area. At this point "homing" takes over and the missile seeks radar echoes bouncing off approaching plane to home on target

) a high temperature, then ejected at high elocities through the nozzle. The guided issile appears to be the logical flying vehicle or the nuclear engine since the missile caries no crew and, therefore, requires a minium of shielding.

In the opinion of many guided-missile experts, the imminent advent of the nuclear et engine will solve the now-critical range roblem. The problems involved in getting ne missile on the correct target is still the ne bringing grey hairs to engineers, physiists and military planners alike.

With the exception of size and shape, most uided missiles, from their travel functions, re pretty much alike; they are adaptations f certain aerodynamic and ballistic prinples to a particular problem. It is in the natter of guidance that they differ widely. The nature of the guidance system in a issile is, of course, largely determined by he function it is to perform.

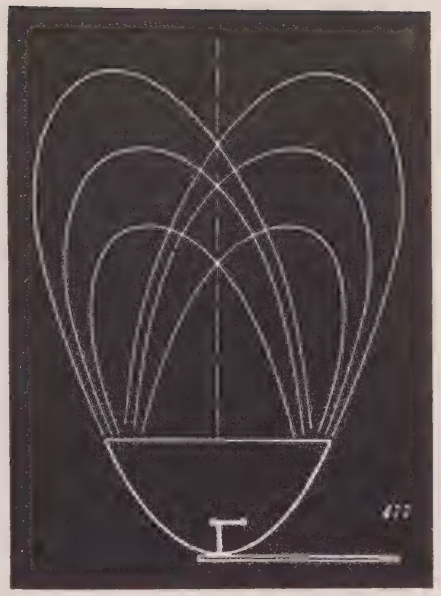
At present, the major concentration in the Jnited States is in Surface-to-Air (flak misiles), Air-to-Air, and Air-to-Surface, all in ne with the essentially defensive program nd policy of the nation.

We do most of our talking about Surface-o-Air missiles chiefly because it gives the ublic a sense of security against atomic atack. Actually, there are probably more kinds f flak missiles than any other of the breed, nd we are closer to real success in this field han in almost any other variety.

Flak missiles are usually small in size and elatively short in duration. Their object is o climb steeply, and to locate and contact n approaching enemy aircraft. The autonotives and aerodynamics of this problem re relatively simple. Guidance, however, is nother story.

There are three general classes of guidnce used in controlling the flight path of urface-to-Air missiles: Command, Beamiding and Homing. Command guidance is ne simplest from the viewpoint of missile esign. The ground observer, tracking the pproaching enemy plane on the radarscope, auses a missile to be launched. Control ommands are transmitted to the missile over rdinary FM (Frequency Modulation) radio hannels. Radar readings of both the approaching aircraft and the intercepting misile are computed and plotted and the issile's course is adjusted to bring the two nto collision. The use of a proximity fuze educes the accuracy required for the actual ontact of interception.

Beam guidance is an electronic variant of ne old light-beam idea, except that the misile rides on radar instead of a light. The ystem usually used for guiding a beamider is a rotating dipole antenna with a arabolic reflector. This radar beam is foused on the approaching aircraft. The elecronics of the missile are designed to keep centered in the beam. One of the common ethods for achieving this effect is to install eceiving antennae in the four cruciform ings which are usually used in flak rockets, et 90° apart on the axis. Each antenna is oupled with an oscillatory circuit whose urrents are amplified, rectified and made to xert energy, via a servo or piston mechanm onto the missile's control surfaces. As ong as the missile stays centered on the eam, and all four antennae get the same mount of impulse, the rocket will travel raight ahead. If the rocket pulls out of ne, one of the antennae will get more im-



GENESIS of tracking beam is rotating dipole antenna in a parabolic reflector

put, and the counteracting control surface will be activated until balance is restored. Thus, theoretically, interception is inevitable as long as the radar operator on the ground can keep the beam on the target.

The third approach to flak-missile guidance is the so-called "seeker." This idea for interception is almost as old as the missile art itself. Originally, seeker heads were devised to track down heat from the engine, or propeller noises or other emanations from the aircraft itself (now referred to as passive seekers). All of these were subject to such elementary methods for jamming and deception that they were soon abandoned.

Modern Surface-to-Air Missiles use three general classes of seekers when this system of guidance is required: the Active, Semi-Active, and the previously referred to Passive system. In Active Seekers, the sensing head of the missile contains a miniature radar transmitter and receiver. Once the tiny radar set recognized the adversary, its control systems "lock on" to the target, coursing it to its doom. Since the missile has a higher speed and rate of climb, is a smaller "package" and is not subject to blackout or other acceleration limits that afflict the man-carrying machine, it has certain advantages over the manned aircraft.

The Semi-Active Seeker system uses a variant of the same idea of homing on a radar echo. However, in this set-up the whole defensive area is floodlighted with radar emanations and the missile is equipped solely with a receiving set. Thus, it homes on the radar echo bouncing off the surface of the approaching aircraft. The Passive Seeker homes on heat, noise or other emanations from the aircraft.

All of these guidance systems have certain advantages and disadvantages. In both the Command and the Beam-Riding system, the accuracy of directional command falls off with the square of the distance: in the case of Command Guidance, because the radar images become smaller as they recede, while with the Beam Rider, the guide-channel widens cone-fashion. Thus, both types lose accuracy at a distance from the transmitter.

The Active and Semi-Active seekers also have disadvantages, but they are of the opposite variety. The searching cone of the Active Seeker's tiny radar set is limited by the size of the antennae that can be installed in the missile. While the active missile is virtually a sure Nemesis for the invading bomber *if* it gets headed in the right direction in the proper range (it gets more accurate as it approaches the target), still this problem of getting it into the right piece of sky is difficult. The same is true of the Semi-Active system, but to a lesser degree.

Consequently, the operational approach in the modern flak-missile is to combine functions. By means of either Command Guidance or Beam Riding, the missile is directed to the approximate location of the invading aircraft. There the missile "recognizes" the approaching aircraft. If the approaching airplane is friendly, it will give off an identifying IFF (Identification, Friend or Foe) signal, a sort of pre-set electronic password that identifies the aircraft to the missile's radar system. The missile then ignores the friendly airplane, and goes on after other targets not equipped with the proper IFF. When it gets in proper range, the proximity fuze sets off the warhead.

There is one other element, an old one which is again being considered in guided missiles; that of man-monitored missiles. We must assume, for the safety of the nation, that the potential enemy will be able to send against us equipment and personnel of no less quality than we can put into the air. This means that an intercontinental bomber with a clutch of A-bombs aboard is a genuine possibility, and that it must be met with practical methods for interception.

General Hoyt Vandenberg's statement that, using conventional means, we could hope to thin down a determined bomber strike by but 30 per cent, has far-reaching significance. Most of our Surface-to-Air guided missiles are radar operated and are, therefore, limited to line-of-sight. Back when the Germans found that their anti-aircraft missiles like the Wasserfall and the Schmetterling were theoretically fine but practically limited, they determined to take the monitoring equipment closer to the target. This called for either a small guided missile that could be carried under the wings of an airplane and be air launched and commanded or beam ridden to the target, or a huge missile with a tiny airplane appended to it like a man riding a whale. Having achieved the required position and altitude in a minimum of time, the tiny monitor aircraft would stay with the missile, leveling it out and heading it toward the target. Then the little plane would peel off, letting the giant missile head for the enemy, first by beam guidance and later by active homing. The German's original object was to break up bomber formations with this system, but with the improvements in technique effected since 1945, such an approach to the problems appears to have merit today, even if it is only a stop gap until radar location systems are increased in range and made foolproof.

On the other side of the problem, Air-to-Surface missiles are the oldest successful military applications of the art. The purpose of the Air-to-Surface missile is to permit the launching of bombs from positions outside the fixed anti-aircraft defenses of an installation. The German radio-controlled glide bombs, which were used as early as 1941,

(*Continued on page 56*)

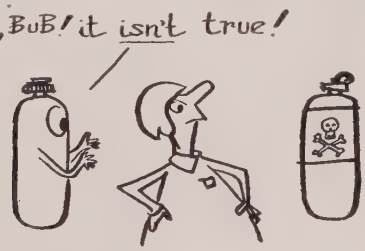
Dilbert

(*Continued from page 35*)

bluster. "Why, there are people in the Himalaya Mountains and the Andes who *live* above the 15,000-foot level without oxygen."

True enough, but that's just the point; they do *live* there. They have become acclimatized, which enables their bodies to function effectively at that altitude. Among other things, their lungs are so developed that more air is taken in at each breath. Also, a sample of their blood would show it to contain almost twice as many red cells per cc. as that of a normal person. And these red blood cells are the babies that carry the oxygen. So, unless you are a mountaineer, be a good boy and take your oxygen.

Another mistaken idea people have about oxygen is that too much of it is harmful. This probably arises from the fact that oxygen poisoning can occur among deep sea divers when breathing oxygen at pressures far greater than that of the atmosphere. Repeated tests have shown that oxygen breathed at the pressures encountered in flight, however, can have no such harmful effects. So breathe freely.



Some people believe you can recognize the lack of oxygen by the onset of panting or shortness of breath. This, too, is incorrect. These symptoms occur only if exercise is being taken. If you are sitting down and the oxygen supply fails, you are very apt to pass out without noticeable panting or lack of breath.

Other important physical reactions due to lack of oxygen:

1. Shorten your range of vision, especially at night.

2. Encourages frost-bite and chilling of the body.

3. Makes you tired and induces air sickness.

4. Most important, oxygen starvation affects your brain power. You are not being tough when you think you can do without it at altitude—only stupid. And unfortunately, the stupider you get from the lack of oxygen, the better you feel.

Don't take risks—take oxygen.

Another Safety Convert—It's strange how hard it is to get aviators interested in their own safety. It often takes an experience such as the following to do it. This pilot was stunting out over Lake Michigan when his plane caught on fire. But let him tell it.

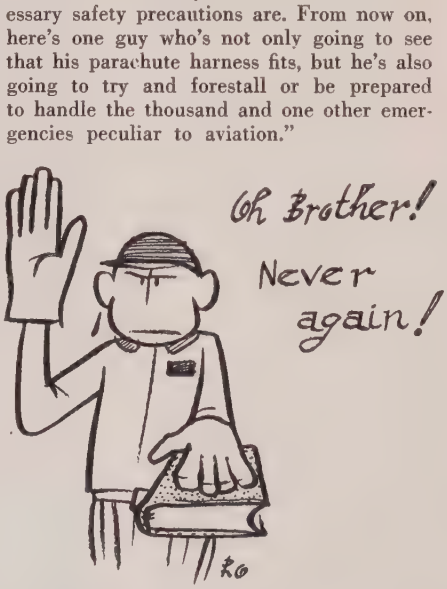
". . . so I rolled the plane over, swallowed half a dozen times, and pulled my safety belt.

"I was held up for a moment when my chute caught on the edge of the cockpit, but I gave a hell of a kick and was in the clear. By that time I was so excited I pulled my rip-cord immediately, even while I seemed to remember that I should count to 10 first. I was lucky; my chute didn't catch on the tail surfaces.

"When I pulled my rip-cord, there was a loud snap and the chute and shrouds spiraled up past me. I remember waiting for the jerk. I got it all right, but it wasn't like the book said. I was jerked by my feet! First thing I knew, I was looking *up* at the water and *down* at my chute. My harness had somehow slipped off my shoulders and miraculously caught around my ankles and feet. Thank God, they're big!

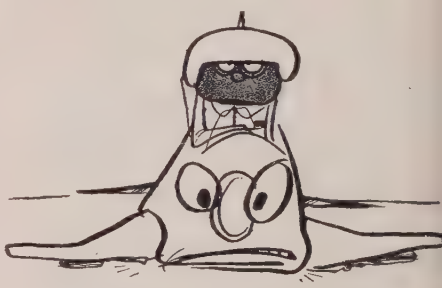
"Everything happened so fast, it seemed like in a dream. Anyway, I finally managed to pull myself up and grab the harness. . . . I hit the water 'stern to' and was picked up by a small boat a few minutes later, with nothing worse having happened to me than a twisted left knee and a few strap burns.

"Believe me, I know just how close that one was. But now I'm glad it happened, because it absolutely convinced me how necessary safety precautions are. From now on, here's one guy who's not only going to see that his parachute harness fits, but he's also going to try and forestall or be prepared to handle the thousand and one other emergencies peculiar to aviation."



Thick and Red—Naval Aviation has a verse for it. It isn't known whether it has been set to music yet, but a sailor wrote the words; which go like this:

"A young pilot with very thick head,
Has a face that is long and bright red;
He had a bad lapse
When he reached for his flaps
And pulled up his wheels instead."



SETH'S SAFETY QUIZ

1. When complete fuel consumption from any tank is necessary, what procedure would be followed?
2. When should you make the idle-mixture check?
3. On take-off, when the horizon is obscured by darkness or overcast, what is the safest flight procedure?

ANSWERS

1. As tank approaches empty condition, fly level; watch fuel-pressure gage carefully and shift tanks as soon as needle starts to fluctuate.
2. After each warm-up.
3. Go on instruments immediately upon becoming airborne. Assume and maintain a safe rate of climb, through instruments; do not make unnecessary turns and do not operate any auxiliary controls or radio until you are at least 500 feet above the terrain.

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Hangar Flying

D Cards

If you are one of the nation's half-million irmen, the CAA advises you to get moving n that application of yours for the identifiation card which will be required under proosed amendments of the CAR's. Pilots, nechanics and other airmen should file their pplications at CAA Aviation Safety district ffices, and they'll need the following:

1. Two identical photos, one inch by one nch in size, full face, head only, taken ithin the past 12 months.
2. Proof of identification, such as licenses r combinations of identification cards and locuments which will identify the applicant.
3. Proof of citizenship, place and date of irth.
4. Airman certificate.

Your fingerprints will go on both the pplication and the issued identification card. Deadline for obtaining ID's is September 1, 951.

Card instead of Passport

Certificated flight-crew members of U.S. lag international carriers now can get a ard from the CAA which will serve in lieu f a passport for temporary admission to oreign countries. Application for this card hould be made at the local CAA Aviation afety office or at the CAA International ield Office. When the application has been pproved, a convenient wallet-sized card will e mailed to the air carrier for delivery to he applicant . . . and there's no charge for he service.

One Instructor's Cure

Louise Blanford of Bakersfield, California, offers this novel idea as a sure cure for some student pilot failings. It seems that one young student flyer was causing her instructor a lot of worry by her too-low approaches to the airfield. In fact, the gal came in so low over the tops of some orange trees in a grove next to the field that many times it seemed as though the wheels of the plane actually touched the trees. Warned over and over again, she failed to correct her approach, so the instructor decided to do something about it. The next time the girl went out to the field for some flight time, the instructor went up with her. In his pocket he had hidden a bright shiny orange. As the two came in for the girl's customarily too-low approach, the instructor leaned down and reached his hand through the lower opening in the side of the *Cub*. The girl noticed his actions and seemed puzzled, but she wasn't puzzled for long. As soon as the *Cub* rolled to a stop, the instructor showed her the orange. "Nice orange I picked as we came in, isn't it?" The errant student flyer comes in at the right altitude now.

Alaska Vacation

Plane owners with a yen for the great outdoors and some good fishing will do well to consider Alaska, according to the CAA. Tucked away in remote corners of Alaska are wonderful resorts and recreation areas accessible only by airplane, and a list of such places has been prepared by the CAA. The list gives the location of the area, what facilities are available for airplanes (landplanes or seaplanes), accommodations and the prices charged, and the special attractions to visitors. Copies of this list can be had from any CAA Regional Office, or from the CAA Office of Aviation Information. Washington 25, D. C.

New Kind of Landing

Emergency situations have turned up a lot of oddities in behavior, but here's one emergency that proved good ole American quick thinking and ingenuity. The Nawab of Bhopal, powerful ruler of a million subjects in India, was being flown home in a Ryan *Navion*. The Nawab's pilot, A. K. McLennan, a Scotsman formerly of the RAF, discovered as he got set to land that the nosewheel wouldn't lock. McLennan's partner and alternate pilot, Dean Kundert, an American, was on the ground at the time. He sized up the situation, hopped into a Jeep and with one hand on the wheel he raced alongside the *Navion* as it came in for a landing. The Nawab had been transferred to the back seat and his servant had been placed in the baggage compartment to make the plane tail heavy. Standing up in the Jeep, Kundert grasped the *Navion's* tail and held it firmly down while the plane rolled to the very end of the runway. Saved from injury: one Indian prince, servant, and pilot; saved from damage: one needed airplane.

Cubs to Battle

Six Piper *Super Cub* spray planes and two war-surplus biplanes equipped for spraying were flown, via airline, to Iran recently to help combat the worst locust plague the country has experienced in 80 years. Eight pilots, all veteran American crop dusters, went along with the airplanes. The sprayers were hastily rounded up after the U.S. State Department received from the Iranian Foreign Minister an urgent appeal for help.

Air Marker Leader

A CAA report credits Florida with leading all the states in 1950 in the installation of air markers, with 165 new ones completed. Alabama ranked second with 141 new markers; Nebraska, third with 140; Wisconsin, fourth with 119; New York, fifth with 115; and Minnesota, sixth with 109.

News Notes

Air-Parts, Inc., through its president Arthur C. Harvey, announces the appointment of William G. Smith to the position of General Sales Manager. Bill Smith was with Lockheed Aircraft from 1939 to 1945.

★

Kollsman Instrument Corp., a subsidiary of Standard Coil Products Co., Inc., has named Jay E. Browder Chief of Radio Communications Engineering Section. Mr. Browder formerly was associated with Sperry Gyroscope Corp.

★

Aeronautical Training Society has announced that Maxwell W. Balfour, Director of Spartan School of Aeronautics, Tulsa, Oklahoma, is its new president. This is the fifth time Capt. Balfour has been elected to head ATS.

★

National Air Races for 1951 will be held at Wayne Major Airport, Detroit, August 18, 19.

AIA CHART shows shipment of 231 one to 10-place planes by 11 companies during April

	Complete Aircraft			Manufacturer's Net Billing Price		
	Shipments			Shipments		
	TOTAL Jan-Apr	April	March	TOTAL Jan-Apr (thousands of dollars)	April	March
Aeronca						
Champion 90 hp	9	2	1			
Sedan	17	2	5	83	12	20
7CCM a/	2	--	--			
Beech						
Bonanza	119	37	30	2,825	654	948
D-18	22	3	9			
Bellanca						
Cruisemaster	7	2	5	67	10	57
Cessna						
140A	35	--	9			
170A	152	46	37	1,402	403	382
190	6	--	--			
195	35	14	13			
Engineering & Research						
G	5	--	1	17	--	4
Luscombe - 8-F	18	1	4	53	3	14
Mooney - M-18	9	3	1	17	5	2
Piper						
Tandem Trainer	186	42	44			
Pacer	240	65	84	1,428	368	444
Clipper	1	1	--			
Ryan - Navion	102	11	24	1,188	131	278
Taylorcraft						
Sportsman	6	1	1	11	2	2
Texas Engineering						
GC-1B	7	1	2	27	4	8
TOTAL	978	231	270	7,118	1,592	2,159

a/ Military type aircraft sold to other than U.S. Military Customers.

CAOA REPORT . .

CORPORATION AIRCRAFT OWNERS ASSOCIATION, INC.

Corporation Aircraft Owners Association is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable corporation aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. The CAOA headquarters are located at 1025 Connecticut Avenue, Washington 6, D. C.

What's Cooking in RTCA

A new Special Committee, including for the first time representation from the CAOA, has been set up by the Radio Technical Commission for Aeronautics to see exactly where we are in the Transition Program of the Common System of all-weather air navigation and traffic control.

It will review the present status of RTCA, Air Navigation Development Board (ANDB), and Air Coordinating Committee's Navigation and Air Traffic Control Panel (ACC/NAV) papers relating to the Transition Program.

It will standardize nomenclature and develop an up-to-date description of the functions of each piece of equipment in that program.

It will prepare a status report of Transition Program equipments listed in the SWG-5 report, as proposed, under development, service test, procurement, installation, in use.

It will recommend a schedule for the development of additional equipments required for the implementation of the Transition Program of the Common System.

It will amend, as may be necessary, the "transition period" section of the SC-31 report to provide a "technical equivalent" of the SWG-5 operational report.

There are 10 other special committees whose activities are continuing. Here are the numbers and names:

SC-18—Automatic Flight Control

SC35—Standardization of Adjustment of ILS and VAR Facilities

SC37—Coordination of Test Procedures and Standards

SC46—Standardization of Aircraft Equipment Control Panels

SC51—DME Test Equipment

SC54—Operational Analysis of the Need for and Use of Course Line Computers in Air Traffic Control

SC56—Implementation of the VHF Utilization Plan and Review of Transition Period Communication Requirements

SC57—High-Altitude Grid Plan fo VOR/DME Frequency Pairing

SC58—Minimum Performance Standard for Airborne Electronic Equipment for th Transition Period Common System.

From time to time brief reports on som of the above activities will be given.

CAOA and the L/MF Ranges

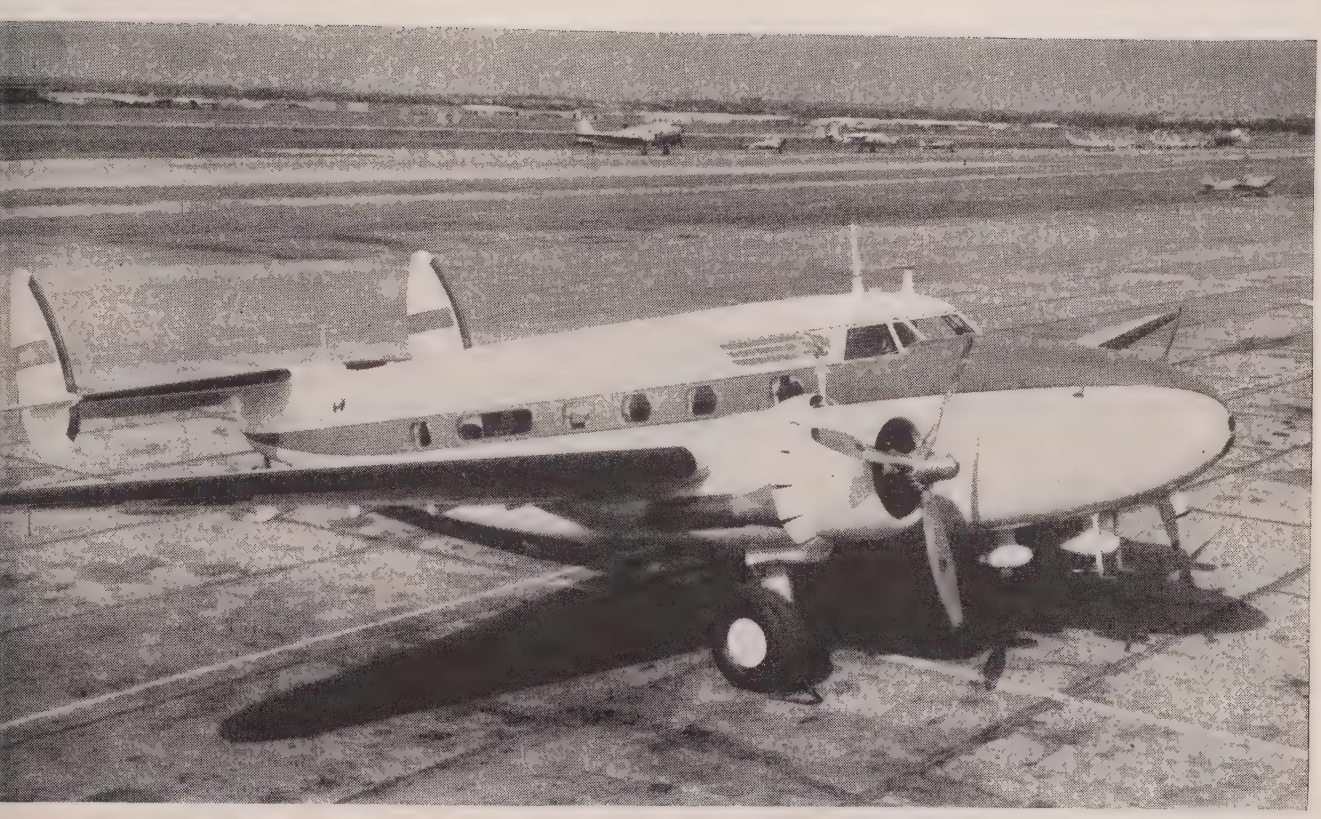
Early in May the Technical Committe advised all members of imminent action b the CAA in starting their program of grad ually discontinuing the low-frequency fou course radio-range stations over a period o years, beginning with fiscal 1952.

In connection with discussion meeting on the subject held in Regions Five, On and Four, letters were sent out to all mem bers in those regions. with a list of th ranges proposed for shutting down, and th suggestion that pilots in each area get to gether and attend the meetings. In case where this was impracticable it was sug gested that letters be sent to CAOA head quarters in Washington.

Just prior to the Region One meeting o June 6, letters were received from Celanes Corporation of America, Armstrong Cor Company, Red Devil Tools and Eastma Kodak Company. All of these letters ex pressed opposition to the discontinuance o the L/MF ranges at the present time. Th reasons in general and the specific objec tions to the shutting down of particular sta tions on the list were outlined.

Some of the reasons offered in the letter included uncertain delivery of the airborn equipment necessary to make the change especially the Collins and ARC (airline type VOR sets desired for multi-engine aircraft insufficient reliability of VOR navigation i instrument weather (many pilots do not trus it enough as yet); and the frequent malfunc tioning, and necessity of maintenance an

FLATTOP-TYPE REFUELER has been developed by Esso. New tender has 75 per cent greater pumping rate to speed up plane refuelin



EXECUTIVE LODESTAR, owned and operated by Mississippi River Fuel Corporation of St. Louis, features a "picture window" for better visibility for passengers

pairs to VOR and ILS ground equipment. n the case of Rochester, N. Y., one com- ny pointed out that the VOR station is just w in process of being relocated, and that ls for the original construction of the ILS d not gone out as of the early part of ne. This means Rochester will not be ready have its L/MF range shut down for at st two more years.

Another company stated that by the re- val of the Wilkes-Barre and Elmira ranges pts in the New York area whose planes not equipped with VOR receivers would e Airways Red 23 and Red 26, an excel- t secondary route to Buffalo, Cleveland l the west.

These points have already been taken up h CAA in Washington who reply that this exactly the kind of information they want m users of the airways, and indicate that ion in some cases will certainly be post- ed.

Defense Identification

As a post-report project, several members of Task Group "C" (Industrial, Business and Agricultural Flying) took a two-week trip to visit the headquarters of the Air Defense Command at Colorado Springs, and the headquarters of the Eastern, Midwestern and Western Air Defense Forces, and 30th Air Division at Selfridge AFB. The trip was set up by Wiley Wright, Office of Aviation Development, CAA, acting chairman of Task Group "C"; Col. A. B. McMullen (NASAO), "Doc" Hartranft (AOPA) were among the other members; Merrill Armour of the Federal Civil Defense Administration and Joe Blatt, Chief of the Planning Staff, Office of Federal Airways went along as observers.

The purpose of the trip was to confer with air defense officers, CAA liaison personnel, etc. regarding the problems of identification of civil aircraft, praticularly non-carrier aircraft. Appreciation of the amount of such flying going on at the present time was very spotty, and it was felt that considerable progress was made in securing a more adequate understanding of the problem.

One tangible result was a request for copies of the CAOA Directory of Executive Aircraft to be sent to all Air Defense bases.

Collision Prevention

Flight Safety Foundation's Accident Prevention Bulletin 51-12 gives the following three steps which should be taken now in connection with the air collision hazard.

1. A strong continuous campaign by every operator to encourage flight discipline—cruise at correct altitude, on the right side of the airway, report positions accurately.

2. Reorganize cockpit procedure in aircraft so that at least one pair of eyes is always looking *out* the cockpit for collision hazards—similar to a watch at sea. The searching pattern should be organized so that all areas will be scanned within definite time intervals.

3. Install collision warning lights which were tested and demonstrated at Denver at the FSF Safety Seminar and by the CAA at Indianapolis. Why wait?

New Members

The following companies have been accepted as members of the Association since our last report.

The J. R. Watkins Company, manufacturer of food and medicinal supplies, Winona, Minn. This company operates a Douglas DC-3C between 600 and 700 hours per year. Ralph Boalt is Vice President, and Jack Ollom (ATR) is the chief pilot.

McCullough Tool Company of Houston, Texas is engaged in oil-well tool manufacturing. The corporation has operated aircraft for over 10 years. Present equipment is a Lockheed *Lodestar*. L. C. Richter is the company pilot.

Over but not Out . . .

(*Continued from page 29*)

pounded into him from the time he started flight training.

In the most recent movie version of what goes on between the tower and the pilot, the tower operator was wearing a set of earphones similar to those worn by telephone operators. He was standing up, peering out into the overcast in an effort to see the aircraft he was working, tripping over telephones, and keying a Buck Rogers type of microphone. If I were a civilian and saw a confused set-up like that, I'd stay on the ground.

Let's get the record straight. We don't wear earphones! We don't have a confused clutter of radio gear strewn willy-nilly all over the place! And, brother, once they turn you loose in a tower, you have been checked out thoroughly on what you are doing—and it is all cut and dried—exactly what you do, when you do it, and how.

Normally there are two operating positions in the tower, referred to as the "A" stand and the "B" stand. The "A" stand operator operates the microphone and actually controls the traffic insofar as take-off, landing, and procedures around the traffic pattern are concerned. In short, he is the boss of the airport, and pilots rely on his judgment as well as the accuracy of his instructions. When an aircraft is ready to taxi out for take-off, all the pilot generally wants to know is the runway in use, the correct time, and the altimeter setting. Then he proceeds down the taxiway, is cleared into position, and away he goes. The pilot may request such information as wind velocity, etc., or he may have to stand by before take-off for a clearance of his flight plan through the Air Traffic Control center in his particular control zone. But normally he is off into the blue with very little fuss. The "A" stand operator also may coordinate with the GCA unit down on the field, and perform various related duties. But he doesn't wear earphones; he doesn't sweat over his job (unless the day is hot); and he is never the befuddled character pictured in the comic books.

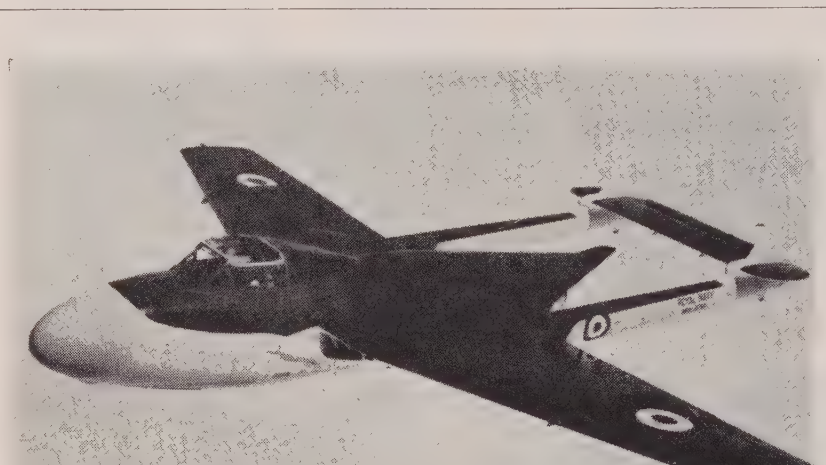
The "B" stand operator takes care of the details that the man on the microphone doesn't have time for. He receives flight plans, advises the parties concerned when an aircraft arrives or departs, keeps up the various log books, answers the telephones, copies hourly weather sequences, and assists in general. Ordinarily, the two operators switch back and forth at intervals from the "A" to the "B" stand, to relieve the strain.

If we are attempting to establish radio contact with a plane that we believe should be in our vicinity, we merely transmit as follows: "Navy so-and-so-, this is Navy such-and-such Tower. Do you read?" Then we stand by to see if the aircraft is hearing us. If it appears that such is not the case, we repeat the message at intervals until contact is made. The pilot answers, "Roger, Navy Tower, this is Navy so-and-so, reading you loud and clear." Or, "weak, but readable," or whatever the case may be.

Of course, there are some cases where an airplane actually does get lost. When this happens, a complicated, well-organized search system goes into action. But before it is definitely determined that the aircraft is lost and not merely flying around with radio receiver out of commission, we start trying to pick him up on radar gear and in various other ways. We don't start tearing our hair, loosening our shirt collars, and acting like the nitwits in the movies. If we did, the poor pilot would really be sunk.

Another over-worked expression is "Roger," which means, literally, "I understand," or "I've got everything straight that you said in your last transmission." Sometimes this is accompanied by "Wilco," meaning "I will comply with your last instructions." When a pilot "Rogers" a message, and is done gabbing with you at the moment, he says "Roger, out," meaning "I understand, and am through talking to you for a while." The Dilberts in the movies, though, would dress this up with "Roger Dodger, over and out," which may sound more glamorous, but is highly incorrect.

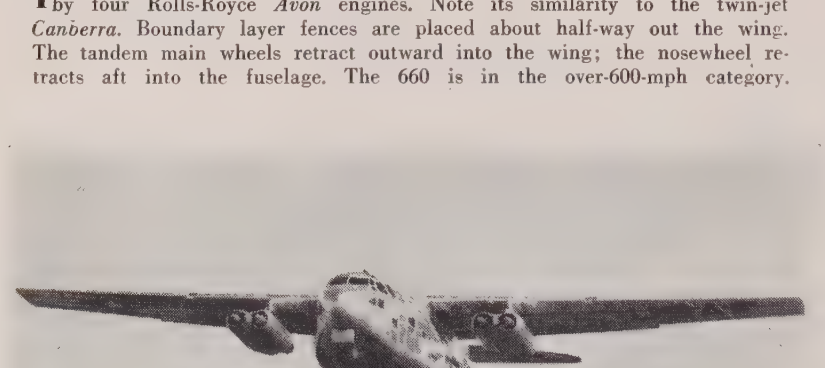
Not so many years ago, when CAA began to develop their network of radio aids to navigation, including range stations and control towers, etc., the boys who pioneered in air-to-ground communications had no standard terminology to guide them. When a pilot understood a message, he would usually say just plain "okay." If he contacted a station and was holding a conversation with it, he would say "go ahead" at the end of a transmission (instead of "Over" as he now would). Even now, some of the



Royal Navy's new jet fighter, the *Sea Venom,* is shown here in one of its first flight photos to be released. The plane, powered by a jet engine of 5,000 pounds static thrust, embodies deck arrester gear and hydraulically folding wings. Its crew of two—pilot and radar operator/observer—sit side-by-side. The plane is noted for its fast rate of climb, maneuverability.

New Jets From Great Britain

The Vickers 660 is the first of Britain's multi-jet bombers. It is powered by four Rolls-Royce *Avon* engines. Note its similarity to the twin-jet *Canberra.* Boundary layer fences are placed about half-way out the wing. The tandem main wheels retract outward into the wing; the nosewheel retracts aft into the fuselage. The 660 is in the over-600-mph category.



who have been in the business for time will slip into some of the old es, but it is unintentional, or just for s—and not good practice, since FCC ors these things. I remember one fellow e Pittsburgh Tower back around 1940 really had a line of his own when it to giving taxi instructions, etc. For ice, in the event he had to refer to a west wind he used "Silly Willy," and east was "Naughty Esther."

ne marched on, the country became ed in a war, and air traffic was on the ase. Not only that, we were working y with Great Britain, and they had oped their own radio phraseology. To operations clearer, radio phraseology tandardized. A phonetic alphabet came oeing, so that now a southwest wind is igar William," and "Naughty Esther" w "Nan Easy." (The guy in Pittsburgh got fancy on a north-northeast wind: s "*Nasty* Naughty Esther.") We really the British for both "over" and "out," igh their term for the latter was "listen- ut." But even they never said "over and

traffic control is now a well-coordi- set-up from coast to coast. It has to an you imagine the fix a pilot would be he was in the stack at LaGuardia, for ice, and the Approach Controller there a set of phrases entirely different from at Chicago?

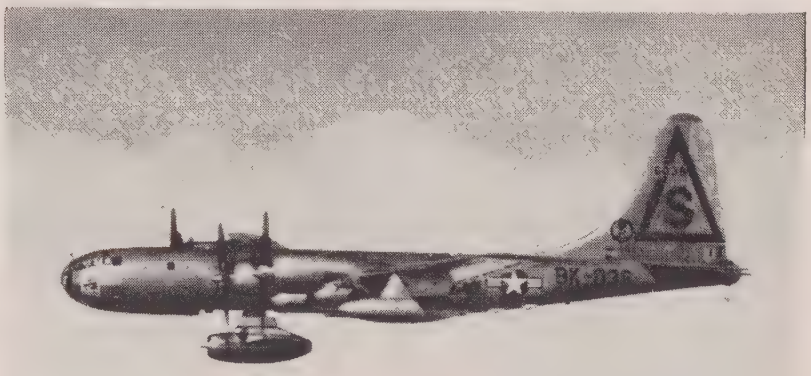
ne pilots have a tendency to become y in their radio technique, but usually s not due to lack of knowledge—they erely backsliding a bit. I believe this e of civilian pilots more so than the ry fly boys. I heard one fellow on 3105 ne night talking to Patricia Bay Radio. oy evidently had seen too many movies: e end of every transmission he would momentarily, and then scream "O-o- rr!" Loud and extremely clear. Cor- used, "over" should merely be the f the sentence—it hangs on the end of onversation like the tail on a dog. In ase the tail was wagging the dog.

ybe we have gone off the deep end on bject, but every Aircontrolman I have l to has the same complaint. Fiction rs and the people who write scripts for s usually try to be authentic in other cts; why don't they get these few icalities right also.

ht here, let's set down a few complaints rial traffic cops have to make against . One big gripe we have (at least at tation) is on clearances. When we re- an ATC clearance from Control for an ft, we are very particular to get it exactly as received. When we pass it the pilot and request him to read it it is for his own protection as well as wn. In fact, we record everything we nit and receive. Most pilots will read it verbatim. But a certain small percent- f the fly boys will get it upside down ackwards. Sometimes we almost have ad with them to *please* get it right. If ll the pilot to climb out on the north- eg to 5,000 feet, we don't merely mean limb to 5,000; we mean climb *north- ound*. There may be somebody else on ther courses of the range, and it is mbarrassing for two aircraft to meet n. One day one of our controllers an approach clearance to a pilot to d inbound on the south*east* course to the range station and hold in the elliptical racetrack pattern on the south*west* leg for further clearance. The airplane driver insisted on reading it back that he would hold south*east*, although he was familiar with our range approach set-up and probably intended all along to go into the standard southwest holding pattern. It took about six transmissions on our part to get it straight on the recorder—and the pilot was disgusted with us, even though it was his neck that we were primarily concerned with.

Normally most of our aircraft use the same VHF frequency, and can hear each other as well as the tower. And yet, many of them think nothing of breaking in on their fellow pilots when they are talking to us. This garbles everything and takes up valuable time to straighten out. We think nothing of it either! Maybe they just don't like each other. More probably, it is carelessness. At any rate, it is certainly irritating. Almost as bad to the Aircontrolman as the Dilbert who leaves his transmitter keyed after talking, thereby cutting everybody off the air. This sometimes results in the controller cutting his throat!

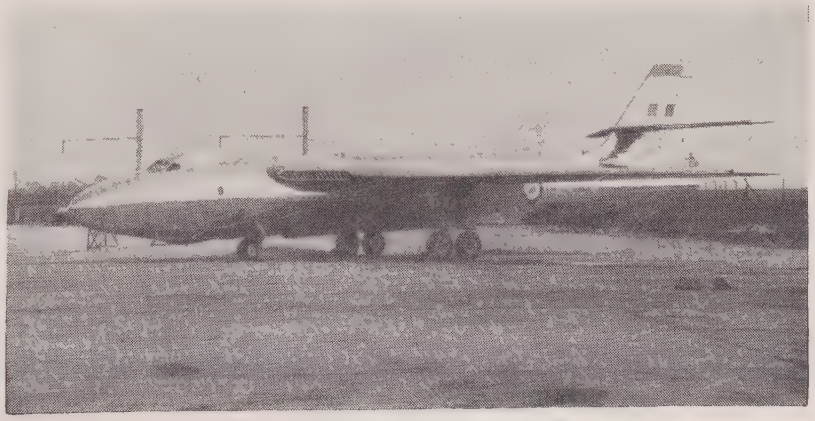
We like our job. We try to help the fly boys in any way we can, and we appreciate cooperation from them. And we are disgusted with the movies for making us look like a bunch of confused jerks. Steve Canyon gets it right; why can't Hollywood? Over—but not out!



The most powerful turbojet flying in the States (at press time) is carried aloft on a test flight by a B-50 *Superfortress*. The engine is the J-57 *Turbo-Wasp* built by Pratt & Whitney Aircraft at East Hartford, Conn. The J-57 is housed in a retractable nacelle that is lowered from plane's bomb bay for test work. This engine is much more powerful than the Pratt & Whitney J-48.

Turbojet News in U.S.

The Chase XC-123A is the world's first jet cargo plane as well as the U.S.' first pure-jet transport. Now being tested by the Air Force, the XC-123A has flown with a gross load of well over 50,000 pounds and has taken off in a run of only 600 feet (and landed in that same area when equipped with a tail brake-chute). The XC-123A is the jet-powered version of the glider XG-20.



Guided Missile

(*Continued from page 49*)

proved inadequate. A bi-fuel powerplant was added later, which permitted the missile to be launched from beyond anti-aircraft range. However, this missile was radio controlled but visually sighted and had serious limitations.

By 1944 and 1945, the USAF was using glide bombs and steerable *Azon* and *Razons* against such difficult targets as bridges and shipping. These were merely conventional bombs with control units in azimuth and in range and azimuth combined. They were visually sighted and radio corrected. All of these early Air-to-Surface missiles had the distinct disadvantage of having visual limits. Later, application of radar sighting permitted the missiles to be used when the weather turned sour. Early in the game, such ideas as heat or light seekers were devised. However, an air-tight black-out, plus a decoy beacon could ruin a light seeker's accuracy, and a pit full of thermite could pull a heat seeker away from a blast furnace or steel mill. While Command or Beam Riding, operating from an airplane, could get an Air-to-Surface missile into a general area, something better is needed for accurate hits. Admittedly, for an A-bomb an area hit is close enough, but there are still situations where an area commander wants to get one bridge or one house, not the whole population.

In this case, television guidance is workable. The missile is equipped with a television camera which transmits to the operator in the aircraft a first-hand view of where the missile is heading. Through telemetered messages, the speed, altitude and direction of the missile is transmitted to the radar-operator missile monitor, who steers the weapon into the target like the old Japanese Baka-bomb pilot, only there is no mourning afterwards. Variations of the Surface-to-Air guidance systems are in some cases applicable to the Air-to-Surface weapon. There are also possible variants of this missile that can seek out a submarine that has plunged underwater for safety. Once the missile hits water, it sheds its aerodynamic equipment and, turning torpedo, seeks the sound or vibration made by the submarine trying to escape.

The Air-to-Air missile is one of the most earnestly cultivated of our current research crop. Obviously, our barreled ordnance, mounted on fighter aircraft, has serious limitations. With the time on target reduced to seconds and fractions thereof, the whole gun battery of a jet fighter, even at 100 per cent effectiveness (50 per cent is a miracle) would scarcely disturb a B-36-class intercontinental bomber.

Ordnance rockets of the Mighty Mouse class are still barreled ordnance, and their accuracy of trajectory is still inferior to a barrel-launched projectile. Since a small guided missile can combine both adequate warhead strength with maneuvering correction while in flight, it appears to be a possible solution to the pressing problem of defense against the A-bomber.

In the Air-to-Air missile, virtually all classes of guidance are possible, subject only to space and weight consideration. The encouraging sign for this phase of the guided missile art is the miniaturization of electronic equipment. Workable vacuum tubes with a

Missiles—Chart A

What? (Component)	Why? (Function)	How? (Implementation)
1. Warhead with fuze	Destruction of enemy	Explosive, atomic or che cal, with proximity or directive fuze
2. Powerplant	Maintain speed and maneuverability	Jet or rocket engine
3. Launching system	To attain speed	Rockets, bi-fuel or solid
4. System for receiving and interpreting intelligence	Guidance and discrimination	Pre-set, electronic or similar systems
5. Power systems	"Muscles" to move command intelligence to control system	Servo-mechanisms, hydraulic or electric powe
6. Aerodynamics	Stability and steering, sometimes lift	Moveable fins, wings ailerons, sometimes impu sors on the rocket strea
7. Airframe	Integration of assembly	Structure using mater yielding optimum stren to weight ratio

CHART A *(above)* **lists components that make up a guided missile, the functions o individual components, and how the components perform their designed functions in**

Missiles—Chart B

Engine	Mach Number Range	Characteristics	Advantages	Disadvant
Pulse jet	0.6	Air breathing, intermittent operation, 2.8 lb fuel per hr per lb thrust	Thrust at zero speed, easy to build, cheap fuel	Erractic at h altitudes, al supersonic sp vibrates bad
Turbojet	0.8	Air breathing, continuous operation, 2 lb fuel per hr per lb thrust	Thrust at zero speed, reasonable fuel consumption	Expensive an complex
Ram-jet	1.5-3.5	Air breathing, continuous operation, .20 lb fuel per hr per lb thrust	No moving parts, high thrust for frontal area and weight, fuel consumption good at high speeds	No thrust a speed, diffic design
Rocket, bi-fuel	open	Requires no air, continuous operation, 18 lb fuel per hr per lb thrust	Thrust independent of speed, better at high altitudes, compact	High specifi consumption, pensive fuels severe cooli problem
Rocket, solid fuel	open	Requires no air, continuous operation, 19 lbs fuel per hr per lb thrust	Thrust independent of speed, high thrust, simple to build and operate	Short duratic high fuel co tion, severe ing problem

CHART B lists the various types of powerplants used in propelling guided missile Mach number range, the characteristics of each, the advantages and disadv

ange of functions have been reduced to t-seed dimensions. Other electronic com-nts are likewise being reduced in size. ng these components to work under the mes of temperature and acceleration na-to guided-missile operation is another er. However, these are developmental ems, and their solution is reportedly ar off.

e Surface-to-Surface missile gets the est amount of discussion these days, al-gh its possibilities are tremendous.

e current military-political situation is ie in that while the tactical situation is range in almost the rifle-shot sense, major strategic problem is ultra-long e—distances in the realm of the inter-nental bomber. Awaiting the arrival of rkable atomic engine, the Surface-to-ce guided missile, the developments of V-2 might be expected to take a back in the development race. However, since rrival of a workable nuclear engine is n the range of predictable science, sys-for control of such a missile are being ed.

e old V-2 missile was controlled in flight re-set built-in gyros and velocity regula-Once it was launched, it proceeded to estination. Since its range was only 200 s, and its velocity supersonic, the oppor-y for error should have been relatively l. Nevertheless, the V-2 was regarded as a random weapon, and if it hit London from the Pas-de-Calais area, it was considered "on target."

If the long-range missile is planned as a substitute for the intercontinental bomber, a far greater degree of accuracy must be provided for its guidance.

There are two approaches to the problem of furnishing a frame of reference for the guidance of an intercontinental guided missile. Men with practical experience in the business of navigation appear to favor the use of straight electronic navigation—covering the area with high-powered pulsed emanations, transmitted from two or more stations, forming lines of well-defined junctures that can be used to make exact navigational fixes in space. The long-range nuclear-powered and atomic warheaded missile could be "educated" to arrive at certain fixes at certain times. The Decca and the Loran systems managed to effect navigation of aircraft by this principle with amazing accuracy. Why not missiles?

Other practical navigators talk a supersonic variety of clock and compass, or even fixed references to the variations in the earth's magnetic field. More romantic seers talk of automatic astro-navigation. Despite its ultra-modern name, this system is a modernization of the method of navigation used by the sea-faring Polynesians who covered the vast Pacific in open canoes, following a certain lore of the heavens; they had to be directly under a certain star at a certain time.

Automatic seeker telescopes are "educated" to seek particular navigational stars, to remain sighted on them for the entire flight. The information concerning the shift in position of the missile in reference to these stars is fed to a computer. This computer has been given, beforehand, the correct course, and the electric brain feeds information on deviations to the control servo system which makes the required correction. The final pass at a specific target can be effected by any of the seeker systems previously discussed.

The military significance of guided missiles is too obvious to require a great deal of discussion. To a large degree, our future diplomacy may depend on the kind of delivery they can furnish for our nuclear warheads and how they can serve as a countermeasure to manned bombers and to other missiles.

Since the guidance systems of all of these weapons are electronic in their nature, they are subject to jamming and other countermeasures. These terms, *countermeasures* and *counter-countermeasures* are likely to be as important as chain mail and armor were in the days of the mounted knight. The business of foiling a missile, whose guidance system is unknown yet whose rate of approach is many times faster than sound, is one for a nimble mind. One well-known psychologist in New York, on considering the problems involved in missile defense, stated that it would make nervous breakdown as ordinary as the common cold among those soldiers and technicians charged with the defense of our cities.

Still, the guided missile like the famed Box of Pandora has its scintilla of hope . . . for in it Mankind has the vehicle for exploration among the stars. All he has to learn is the science of living among his neighbors on earth. That's a problem long overdue for solution.

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NEW CANOPY AIR HANGAR DOOR—FOR SALE: Manufactured by Overhead Door Corp. of Hartford, Indiana under their Contract #2570 in 1947, but never installed or used in any way; factory's present market price now $2,480. Door size: 40'1½" x 10'1½" with (1) pass door left hand facing from inside. Controls: (1) Model "M", Type "C", ¾" H. P. control for left side mounting (current 220 volt, A.C., 60 cycle, 3 phase); and (1) thermal cut-out switch #120. Total weight approx. 4,754 lbs. Door and accessories are available for inspection at Peoria, Ill. Will sell complete for $1,500., F.O.B. Peoria, Illinois. Terms: $2,200 down, balance of $300 within 10 days from shipping date. Contact C. Iber & Sons, P.O. Box 899, Peoria, Ill. (PH. -44910).

FOR SALE Aerial camera. Keystone F8. Like new. Make offer. Mr. A. B. Parlik 1720 South 8th Street, Milwaukee 4, Wis.

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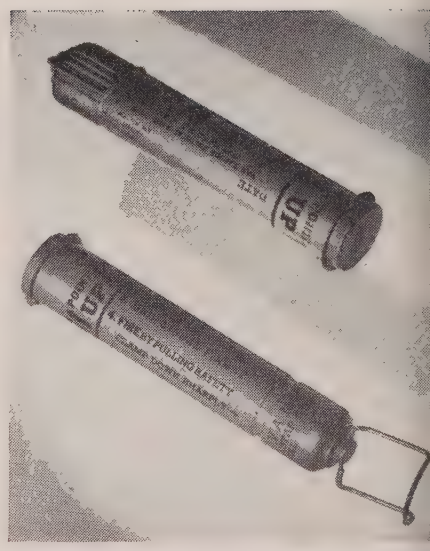
BIG BEAM 700 is powerful portable handlamp designed to throw 2,000-foot light beam; is powered by four dry cell batteries. Costs $19.25 with bulbs. U-C Lite Mfg. Co., Chicago.



V-1 RED STAR ROCKET is new pocket-size night-time distress signal that fits into pocket of flight jacket. It projects thousand candlepower of light 350 feet in air. Van Karner, N.Y.

SCOOTER CUB folds to 15 by 18½ by 24 inches in 15 seconds; weighs 50 pounds. Gives 100 miles per gallon at 25 mph. Can be carried in plane. Argyle Co., Colchester, Ill.

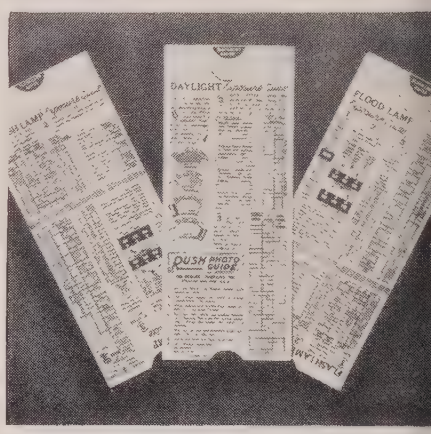
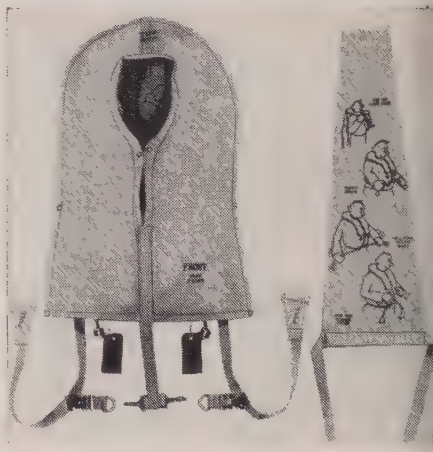


PHOTO GUIDE for pilots who want to take pictures of aerial vacations; is pocket-size "slide rule" providing quick determination of exposures. Rush Co., Syracuse, N. Y.

WEATHERMETER is a pocket-size forecaster. Set wind direction on outer dial, barometric pressure on smaller dial in line with wind direction. Set main index point against these two values and read off forecast in code. Swift & Anderson, Boston, Mass.



LIFE JACKET developed by Air Cruisers Co., Newark, was designed for speedy, foolproof donning, positive safety. Instant inflation of inflatable chambers is accomplished by jerking pull chords of CO2 cartridge.

HERO FIRE EXTINGUISHER is an easy-to-use extinguisher that provides 16 ounces of non-damaging fire-fighting carbon tetrochloride that will stream out for 12 to 18 feet; will stop gasoline, grease, oil and electrical fires. Bostwick Lab., Bridgeport, Conn.

SILO-SPRAY is a new wax spray that will do waxing job in 10 minutes. It contains General Electric Silicones to give plane surface high gloss; is resistant to moisture, heat and sunlight; Coating will withstand weather six months. CCR Corp., Bridgeport.

CAOA Flight-Tests Zero Reader

Technical Committee chairman of CAOA flies a Zero-equipped C-47

By Col. N. F. SILSBEE

Having read articles on the Sperry rp. 'Zero Reader' for over two years, more than welcomed the opportunity seeing it work. George Wies, Sperry's dely known and ever genial aero- utical sales engineer, set up a flight one of the Sperry C-47's from La- ardia, following a recent meeting of directors of the Corporation Aircraft vners Association.

AOA Tries Reader ▶ Cole H. Morrow, ief plant engineer of the J. I. Case Com- ny and chairman of CAOA's Techni- Committee flew the plane, with Ed illiams, Sperry's chief test pilot, in the pilot's seat. John Dunham, pilot of United Cigar-Whelan Stores' Twin ech, and your reporter were close servers in the cockpit to see how well r TC chairman got along.

First of all Ed Williams gave us a ck run over the instruments we were ng to watch. The three distinctive ro Reader' components were the In- ator, Heading Selector and Selector itch. To the right of these and ost dead center in the panel were Cross Pointer Meter and the VOR aring Indicator and TO-FROM Meter the Collins 51R-2 VHF receiver. To right again was the second set (co- ot's) of 'Zero Reader' dials.

Ed then went on to explain that 'Zero Reader' was essentially an au- natic computer, and the pilot acts the servo of an autopilot. he 'Zero Reader' uses your eyes and scles to keep those hairlines centered the ZR Indicator; you use its quick- nputing brain. The result is the easi- smoothest flying you ever saw. It ws up the displacement from your rse and then tells you exactly how bring your plane back on course by tomatically combining the readings of gyro horizon, directional gyro, mag- ic compass, sensitive altimeter and io beam. Without the 'Reader' you uld have to take these five ever-chang- values, piece them together, and con- uously calculate mentally how to ve the controls. The 'Zero Reader' eliminates this tedious mental process and simply tells you to turn right or left, to nose up or down. That is why some of the first pilots to put it through its paces in actual flight demonstrations called it the How-to-Move-the-Stick In- dicator.

Test Flight ▶ Ed said we were going to head for Westchester County Air- port (HPN), do a simulated ILS ap- proach, then head for New York Inter- national (IDL), and do another, then back to LaGuardia (LGA). As some of us had to catch commercial planes there was not going to be time to demonstrate the uncanny all-automatic "hands-off" approach with the A-12 Gyropilot. We'll do that another time.

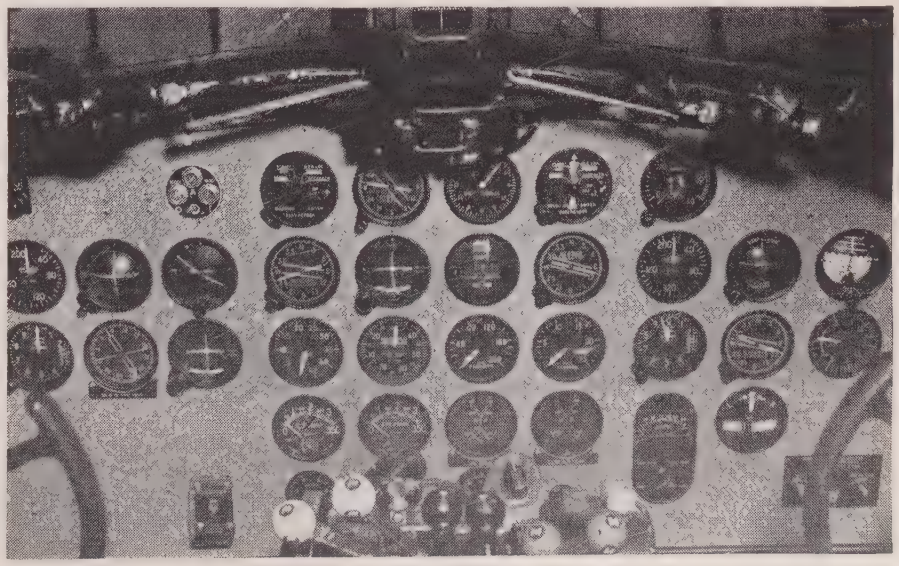
We took off from LaGuardia on the ILS localizer heading and after climbing on the 'Zero Reader' to 2,000 feet and leveling off, Ed turned on the constant- altitude control. Then he set the lubber lines of the Heading Selector to 30° and told Cole to just watch the ZR Indi- cator and fly the plane in such a way that the horizontal and vertical lines would be centered. At this point the vertical line was to the left of center, and was saying "Fly left." Cole moved the wheel to the left and when the plane banked the line swung back to zero al- most instantly. The needle on the Head- ing Selector began to swing to the left and in a few moments it was well within the lubber lines. Meanwhile, whenever the plane gained or lost a few feet of altitude, the horizontal line on the ZR Indicator told Cole to "fly up" or "fly down" in order to hold his 2,000 feet.

Soon we were over Westchester Air- port. We learned from HPN's tower that the ILS glide slope was under re- pairs, so we simply flew a constant alti- tude run on the localizer.

With the ZR Selector Switch still on "Flight Instruments," Ed turned the Heading Selector to 341° to head us out a few miles parallel to the localizer leg. Cole zeroed again and the heading needle quickly swung around to 341°. In a few minutes we would be out far enough to turn and begin our approach.

After passing the radio locator at the outer marker on our left, Ed set the Heading Selector to 161°, which is the inbound heading of the localizer. Cole zeroed again and the plane began to turn sharply to the left. At the same time the vertical bar on the ILS cross pointer meter began to swing towards the center, indicating that we were going to cross the beam. By the time we had turned about 90°, the bar had passed the center of the meter. At this instant Ed switched the (*Continued on page 64*)

INSTRUMENT PANEL of this C-47 includes Zero Reader installation. Instruments are *(center panel, left to right):* ZR Selector Switch, Master Gyrosyn, Radio Compass, duplicate ZR Selector Switch, *(2nd row)* ZR Heading Selector, Collins 51R Cross Pointer Meter, 51R VOR Bearing & To-From Meter, duplicate ZR Heading Selector. ADF is on left of panel



Navy's BuAer Initiates at NBS Progam of Miniaturization of Radio Equipment

As more and more electronic equipment is being stuffed within the limited space of military planes and tanks, reduction of size and weight has become increasingly important. This is especially true of the various all-weather interceptor-fighters coming off the production lines for the Air Force and Navy, where every cubic inch and every ounce counts.

NBS Development ▶ Navy's BuAer has, therefore, initiated at the National Bureau of Standards a broad program for subminiaturization of airborne equipment. Designed and constructed as part of this program was a 12-tube subminiature radio receiver for aircraft use, continuously tunable from 190 to 550 kc and utilizing a 135-kc intermediate frequency amplifier. It was developed by Gustave Shapiro and associates of the NBS. In conjunction with a previous high-frequency project, a 60-mc 11-tube intermediate frequency amplifier assembly, the tiny receiver (panel is 5¾ by 1⅞ inches) effectively brackets an important section of the communication spectrum.

Reduced Size ▶ The new radio-range receiver occupies about 55 cubic inches, whereas the volume of the original version used in World War II was about 300 cubic inches.

To facilitate mass production seven detachable sub-assemblies, each of which can be built independently, are employed in the receiver. This also permits somewhat easier servicing.

Printed circuits are used to a considerable extent. They are of value both in conserving space and for economical mass production. The wiring is "printed" on steatite or silicone-impregnated Fiberglas. This is a truly revolutionary technique of which a great deal more will be heard in the not too distant future.

Aside from its inherent usefulness as an ultra compact piece of airborne communication equipment (with a possible special application to high-altitude operations where current VHF sets are presenting problems), the new range receiver has also served as the focal point for the development of several novel components and fabrication techniques. These components, engineered to meet the rigorous size and temperature requirements of subminiature equipment, may well afford superior permanence and reliability when used in equipment of more conventional and less compact design.

CAA Regions One, Four and Five List L/MF Stations Due to Be Discontinued Soon

Further details are now available regarding the program for discontinuance of a number of four-course low/medium frequency radio ranges during fiscal year ending June 30, 1952.

CAA's Region One came up with a list of nine such stations for discussion by user groups. They are as follows:

Floyd Bennett, Elmira and Rochester, N. Y.; Sprague ville, Me.; Squantum, Mass.; Erie and Wilkes-Barre, Pa.; and Morgantown, W. Va.

Except for Floyd Bennett and Squantum, all of the locations listed will be served by VOR ranges. It is expected that the decommissioning of any particular L/MF range would be contingent upon commissioning of a VOR range in the area to assure continuous navigational aid.

The Fourth Region's proposal of eight facilities for discontinuance in fiscal 1952 is as follows:

Beaumont, Clarendon, Galveston, Midland, Palacios and Richmond, Texas; Monroe, La.; and Hobbs, New Mexico.

These should be followed by 11 more in fiscal 1953:

Austin, Bryan, San Angelo and Tyler, Texas; Alexandria and Baton Rouge, La.; Stuttgart and Walnut Ridge, Ark.; Hot Springs, Las Vegas and Rodeo, New Mexico.

In the Fifth Region the eight L/MF four-course radio-range stations tentatively selected for decommissioning during fiscal '52 were:

Advance, Joplin, Kirksville, St. Joseph and Vichy, Missouri; Sioux City, Iowa; Lebo, Kansas; and Hayes Center, Nebraska.

Meetings for discussion with user groups have been held at the various regional centers. No reports as to the results of these meetings have come in up to press time, but it is certain that one point will have been strongly emphasized at all of these meetings and that is the uncertain delivery of the airborne equipment necessary to make the change-over to VOR at the present time, and also the failure to set up VHF approach procedures.

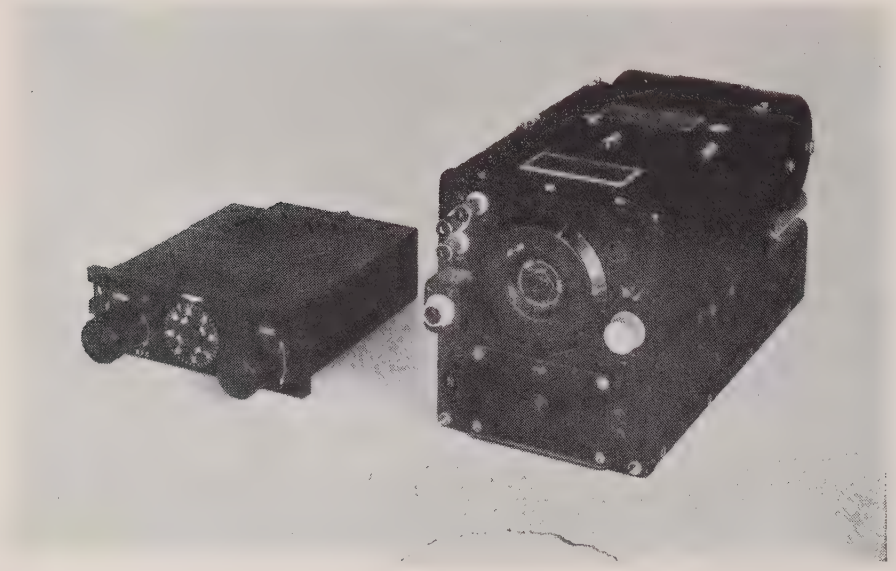
New 'Triple-Threat' Radio Combination for Communication, Navigation Offered

As the CAA's goal of a greatly improved VHF/UHF system for both communications and navigation appears on the near horizon, it has become more than ever necessary to have the airborne equipment to "go VHF." Collins Radio Company has a versatile triple-threat combination that in itself will just about do the entire job, both for the immediate present and the foreseeable future.

Model 17L-2 ▶ The first unit is the Model 17L-2 VHF transmitter which provides a total of 180 channels on the VHF communication frequency band between 118 and 135.9 mc. This is on a 100 kc separation basis, or 10 channels per megacycle. All of the channels assigned in this range are easily selectable over a simple and positive control system. The power output on radio-telephone is conservatively rated at 8 watts, thus assuring that transmissions will be received and acknowledged at the busiest air terminals.

The 17L-2 was designed to replace the transmitter section of the World War II AN/ARC-1 VHF transceiver built by Western Electric, with normal 10 channels, adjustable to 20; an AERO-COM modification kit brings this to 50.

NBS-DEVELOPED subminiature radio receiver *(left)* uses one-fifth space of W.W. II set *(right)*



51R-2 ▶ The second unit in the is the Model 51R-2 communi-navigation receiver, with 280 els. This set was designed to ful- navigation and communication ng requirements of all types of y, commercial and corporation t using the 108 to 136 mc band on xc channel basis. Any one of these annels may be selected from the t over a positive nine-wire con-stem. The set weighs 28 pounds. 51R-2 provides for ILS localizer, ype (including flag alarm when stem is not working), which now en officially adopted as standard. stive tests at Indianapolis and else- indicated the phase type had a light edge in certain ways over ne type, but the difference was so RTCA decided that it was not the extra expense and delay.

omatic omnirange (VOR) indica- provided through selsyn differen-ving combined ADF and magnetic ss presentation on the radio mag-indicator (RMI). VOR indication provided on cross-pointer meter, ourse chosen by manual bearing or; includes operation of TO-I indicator and flag alarm.

ce communication is provided on er and omniranges as well as on gular VHF communications chan-

280-channel 51R-2 was designed place the receiver section of the RC-1 (10 channels) plus the BC- localizer receiver (six channels); cluding the omnirange channels away with a separate receiver for However, the airlines find it ad- to use two 51R-2 sets, one for inications and the other one for tion.

order to provide a maximum of ing convenience, flexibility and s in space and weight, the 17L-2 itter and 51R-2 receiver can be ed in the standard Collins dual nount for either a two-way VHF unication package or a combined tion and communication set.

51V-1 ▶ The third member of am is the 51V-1 ILS glide slope er. This 20-channel set was de- to provide higher stability, ac- and sensitivity than the war sur-89B/ARN-5A 3-channel set which aces (some of these were modified ive 10 channels).

51V-1 receives 90/150 cps tone ated glide slope signals on any 20 channels in the UHF range 335 mc, in accordance with Aero-al Radio, Inc. (ARINC) and USAF cations. It can be mounted in the shockmount which supports the s R89B, some thousands of which operation by military, commercial rporation aircraft.

rate Planes Lead ▶ Of these three classes which make up the bulk of the airplanes using the Federal airways, the corporation aircraft lead the parade in the matter of airborne equipment for the transition program of the new VHF common system. The reasons for this are not far to seek. American corporations have always been willing to spend money to advance the safety, utility and efficiency of the equipment used in their business, and this has proved true of the company airplane. As the CAA completed the first batch of ILS installations and VOR stations, owners of company planes purchased the necessary airborne equipment to use them.

While the ATA's engineering and operations people were putting the stuff through the exhaustive tests required before it could be accepted for operational use for scheduled airline service and purchased in blocks of 150 to 250 or more for the large airlines, corporation aircraft operators were buying and installing the earlier versions of the Collins, Aircraft Radio Corporation and other VHF sets, and putting them to work. The practical use of VOR throughout the country was very largely pioneered by company aircraft and private pilots. Collins reports that some 50 of the pre-production 17L-2 transmitters, for example, were sold to corporation aircraft owners.

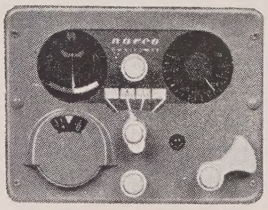
Among the owners of converted DC-3Cs' which are equipped with both the Collins 17L and 51R are Sinclair Refining (2), Reynolds Metals (2), Gaylord Container, Arthur Godfrey Productions, Hercules Powder, Pacific Mills, Minnesota Mining & Manufacturing, The Murray Corporation, etc. Similarly equipped converted *Lodestars* and *Venturas* are those of Bethlehem Steel (both) units), Republic Steel, Champion Paper and Fibre, and Superior Oil (51R-2 only), and Weatherhead (17L only).

Of the Twin Beechcrafts, Sinclair Refining has three with both units, and Rock Island Lumber, one; W. C. Langley's plane has the 51R. In the converted bomber class the Fairbanks Morse B-23 has both jobs, International Harvester has the receiver; some of Superior Oil's fleet of Douglas B-26's have both units, some have receiver only; Albert Trostel & Son's B-25 has the Collins omnireceiver. The Texas Company planes also have several of the units.

These are but examples to show the trend. The only trouble now is that Collins is up over its ears in supplying the airlines and the military, and also has an important part in the military UHF communications program. However, if and when the pressure of "priority" production is relieved, Collins Radio will lose no time in supplying equipment for civilian use, and the swing to the VHF common system will be complete in the corporate aircraft field.

New! Low Cost!

OMNIHOMER



OMNIHOMER

Now, a complete omni range and two way VHF in one Low Cost Unit. The new OMNIHOMER is precision built for peak performance. Installation is convenient: all controls incorporated in one simple panel, size 5¼" x 6⅞" x 10¼" and weighs only 10 lbs. installed. See your NARCO Dealer.

DELUXE

For those who desire the finest in omnigation, NARCO'S VTR-1 Omnigator has all the above features, PLUS ILS, marker beacon receiver, and 8-channel VHF transmission.

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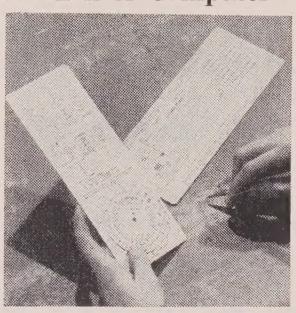

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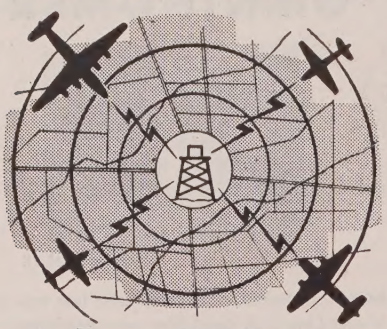

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CAOA Tests Zero Reader

(*Continued from page 61*)

ZR Flight Selector to our "ODR-LOC, Blue Right." (ODR-LOC means Omni-Directional Range—Localizer). Cole was still zeroed so the 'Zero Reader' immediately began to guide us into the ILS localizer. Cole followed the ZR Indicator easily with a few smooth movements of the wheel and kept it nearly on zero. This caused the plane to make a sort of S-turn which brought us gently onto the localizer. We could see this on the ILS cross pointer meter as the vertical bar swung slowly back to center and stayed there.

The rest of the approach was uneventful. Cole just sat there and held her on zero while we crossed the inner marker and then flew along with the center of HPN's instrument runway directly below us. It looked easy.

Ed then explained that our unorthodox procedure for turning around to get on the localizer was done to save time. Switching back to "Flight Instruments" Ed turned the Heading Selector to 180°. Cole zeroed and we began to turn south for New York International Airport.

Ed explained that when the ZR Selector Switch is set to ODR-LOC, the Collins receiver can feed either ILS localizer signals or VOR signals into the 'Zero Reader.' VOR provides an additional signal by which the 'Zero Reader' can fly cross country and around terminal areas on the VHF Omni-Range. Signals from a course-line computer can also be used. The 'Zero Reader' can put you on and keep you on any radio flight track.

Meanwhile, Ed had tuned in IDL's localizer on the Collins receiver and now the vertical bar on the cross pointer meter began to move towards the center, showing that we were approaching the back course of the ILS localizer. As we crossed through the course Ed switched to "ODR-LOC, Blue LEFT" and set the heading to 222°. This caused the 'Zero Reader' to swing us onto the back course of the localizer. Passing over the field, Ed turned off the altitude control and set the descending pitch trim on the ZR Indicator. We descended to 1200 feet, turned on the altitude control again and continued outbound on the approach leg of the localizer.

A few miles past the outer marker, Ed put Cole into the procedure turn by switching to "Flight Instruments" and setting the heading to 42°. Cole zeroed and the plane swung out of the localizer. After about 90° of turn, Ed switch "ODR-LOC, Blue RIGHT." We tinued to turn to the left and whe began to swing towards the loc again, the plane S'ed right onto beam. All this maneuvering requir thought on Cole's part. He just ke zeroing while the 'Zero Reader' fi out how to get us onto the inb localizer.

As we eased onto the beam the cal bar of the ILS cross pointer swung down to center and hung th if it went dead. To prove it was Ed gave the wheel a right twist to us out of the path. The vertica swung to the left. When Ed let go, kept on zeroing and the 'Zero Re pulled us right back into the bean a robot with a one-track mind.

We neared the outer marker an horizontal bar on the cross pointer began to move down towards the c of the meter, showing that we beginning to intercept the glide When the bar reached the cente switched to "Approach" and the alt control snapped off. Now, in pla the altitude control, the glide slop feeding signals to the horizontal li the ZR Indicator.

The line moved downward sli This meant we were going abov glide slope and commanded Cole down!" Cole eased the stick forward as the nose began to drop, the hori line zeroed again, meaning " enough! Don't tilt her any furthe

Now we were on the landing p final approach smoothly following the localizer and the glide slop backed off on the throttles as Cole both lines on zero. Airspeed dropp 110 mph. Now we were in the g

Cole found that all he had to d "stay with the needle" rather tha ticipate the needle as has to be do a conventional ILS approach. Aft erting just a little pressure (pu push) to keep her exactly on the the needles zeroed themselves im ately after the stick was moved.

The inner marker passed by headed down the approach light the runway spread out before u "broke out" exactly over the cen the runway and glided along 10 feet above it. Near the end Ed p on the coal and we pulled up headed for LGA to catch our airli

As far as we could find out, th bad thing about this 'Zero Read that you can't get one without w six months. George has had to do of jockeying around, but has mana deliver about 30 or 35 more to con aircraft pilots who aren't discoura a few months delay.

We have checked with a num them and have yet to find a pilo is not "hepped" on the 'Zero R

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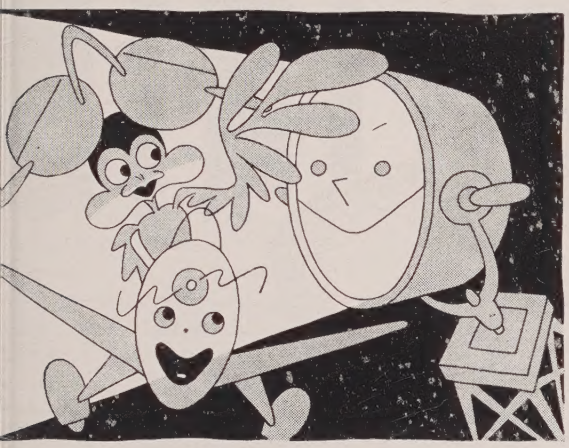

It's a fact, a discontinuance and disposal program was eady under way by the CAA when the squawks began.

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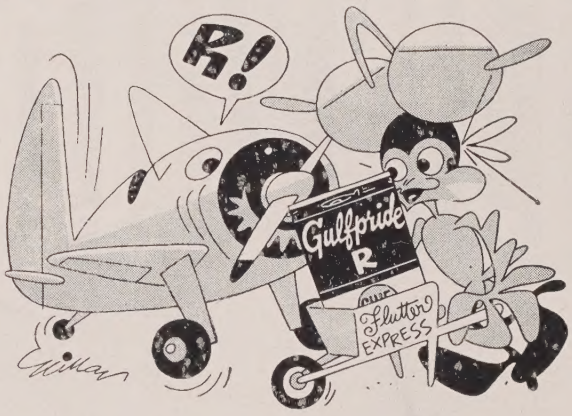

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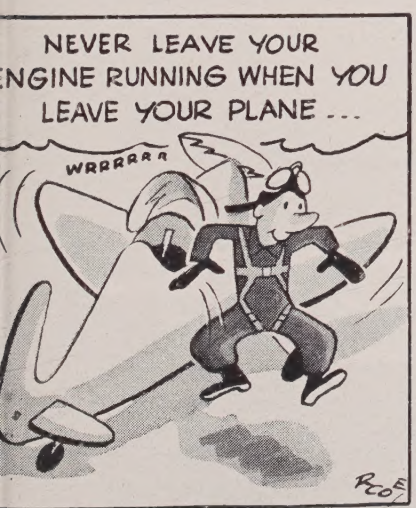

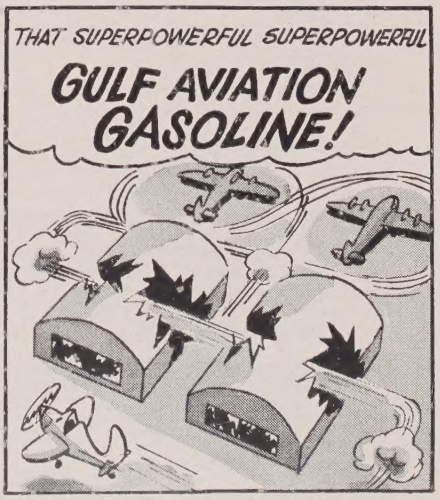

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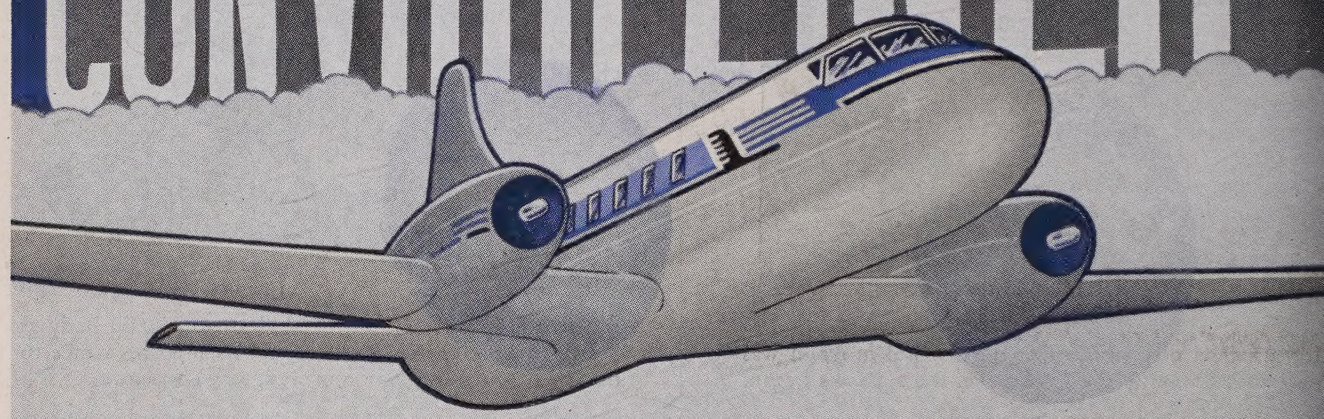

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